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America Leads In Shipbuilding

VESSELS built in the United States and officially numbered by the Bureau of Navigation, Department of Commerce, during the fiscal year ended June 30, 1919, totaled 2,182 of 3,739,372 gross tons. In addition to this, 59 vessels of 121,112 gross tons were built for foreign owners, making the total output from American yards for the year 2,241 vessels of 3,860,484 gross tons. This amounts to two-thirds of the world's output for the year and is nearly 16 percent greater than the total world's output in 1913, the year in which the largest tonnage of vessels was produced in the world before the war.

With this record-breaking output, the American merchant marine on June 30, 1919, had grown to approximately 27,300 vessels of 12,800,000 gross tons. To this total there should be added 56 ocean steamships of 405,000 gross tons which are temporarily employed as transports and troop ships by the Army and Navy. During the past three months—that is, April, May and June—the American merchant fleet was increased by slightly over 1,000,000 gross tons. At the present time half of the American merchant tonnage is registered for foreign trade—a situation without parallel since 1856. For purposes of foreign trade, attention may be confined, generally speaking, to sea-going vessels of 1,000 gross tons or over, of which on June 30, 1919, our merchant fleet included 2,058 of 7,300,022 gross tons out of the total of 12,800,000 gross tons (not including 405,000 gross tons in military service). How enormous this growth has been is shown by the fact that on July 30, 1914, just before the war, the American fleet of sea-going vessels of 1,000 gross tons or over numbered 755 of 2,128,731 gross tons out of the total fleet of 7,928,688 gross tons.

The tonnage of sailing vessels during this time has increased inappreciably—less than 2 percent. The tonnage of wooden sea-going steamships of 1,000 gross tons, however, has increased from 8 vessels of 10,595 gross tons on June 30, 1914, to 293 vessels of 693,541 gross tons on June 30, 1919.

The transfer of ships from foreign flags to the American flag virtually ceased during the past fiscal year, the only additions from foreign countries being almost exclusively Japanese tonnage bought by the United States Shipping Board. The transfer of ships from the American to foreign flags during the same time amounted to only 38,200 gross tons. Ships lost and abandoned during the first nine months of the fiscal year aggregated 267,485 gross tons, and for the whole year will only slightly exceed 300,000 gross tons.

This record output from American shipyards places the United States, for the second time in over half a century, in the first place in the world's output of shipping.

1,000-Foot Ships to Be Built

FOLLOWING closely upon the heels of the record-breaking output of American shipyards during the past fiscal year comes the announcement of the Shipping Board of its intention to build two 1,000-foot, 30-knot passenger liners of 55,000 gross tons each for transatlantic service. These vessels, it is stated, will have a beam of 102 feet, a depth of 74 feet and a draft of 35 feet. Provided with propelling machinery capable of developing 110,000 horsepower on four shafts and a cruising radius of 7,000 miles, these new ocean greyhounds will cut down the passage to England to four days. Accommodations will be provided for 1,000 first class, 800 second class and 1,200 steerage passengers, besides a crew of 1,000 officers and men. These vessels will be built with a view to immediate conversion into naval auxiliaries in the event of war, and in this connection Chairman Hurley of the Shipping Board has recommended in a letter to the Secretary of the Navy that the ships be constructed under the supervision of a committee composed of Rear Admiral D. W. Taylor, U. S. N., chief of the Bureau of Construction and Repair, chairman; Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company; Joseph W. Powell, vice-president of the Bethlehem Shipbuilding Corporation, Ltd.; N. A. Neeland, president of the New York Shipbuilding Corporation; H. G. Mull, president of the William Cramp & Sons Ship & Engine Building Company, and W. F. Gibbs, naval architect of the International Mercantile Marine Company.

While this project is still in the preparatory stage of development and definite action as to the placing of contracts for the construction of the vessels has not yet been taken by the Shipping Board, nevertheless, according to statements made by Mr. Hurley before relinquishing his post as chairman of the Shipping Board, the adoption of the plan is certain and in all probability the construction of the first two vessels will be followed by the construction of two other similar ships, making a fleet of four giant transatlantic flyers, American built, American manned and American classed, representing the last word in safety, speed and luxury in ocean liner construction. That the Shipping Board is in a position to build these vessels without financial or other authorization from Congress is found in the fact that in passing the last appropriation for shipbuilding Congress specifically provided that the Shipping Board might dispose of its smaller ships and use the funds thus realized to build larger vessels in order to balance the merchant marine fleet. The Shipping Board already has at its disposal several of the large German passenger liners, seized during the war, but more passenger vessels are needed, and the proposal to build

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this fleet of super-leviathans is fully in keeping with the determination of the United States to forge its way into a leading position in the shipping world. Recent figures show that the Shipping Board now has 829 vessels of 4,248,973 deadweight tons engaged in the general commerce of the seas, exclusive of more than 2,500,000 tons still in military service and in overseas civilian food relief work. Sixty-two regular cargo lines are now in operation by the Shipping Board on trade routes which have been opened in the last six months as one of the first steps in the conversion of ocean-going tonnage released from war work to commercial service. With regular American cargo steamship lines now in operation from the United States to every quarter of the globe and with new lines to be established as fast as new tonnage becomes available there is every reason for the United States to build vessels of a type specially suited to meet competition in the direct transatlantic passenger traffic. The plan of the Shipping Board to build the 1,000-foot ships is well conceived and should be put into action with all possible speed.

Revision of the Navigation Laws

OVER three months ago in an address on the relation of law to the development of our merchant marine, delivered at the sixth National Foreign Trade Convention, a New York lawyer asked the following pertinent question:

"Is there a person present who needs to be told that, due to the high costs of construction, operation and maintenance, caused by tariffs and restrictive measures that practically limit American registry to American-built ships; that require a more extensive menu for seamen; that limit the operation to citizen officers and to crews three-fourths of whom must be able to understand English; that require a wage scale in excess of any obtaining in the wide world; that sanction contracts which, so far as the seamen are concerned, are mere scraps of paper which can be breached by the men practically at will and without penalties; that prohibit owners from forming pools or combinations to stabilize rates, apportion and give definiteness to sailings and prevent destructive competition, unless sanctioned by the whims of a board politically organized; that limit insurance to corporations or associations which are required, in most states in which they do business, to deposit a large percentage of their capital for indemnity purposes; that require more officers and men to man ships than practice and experience requires or justifies; so long as such laws and restrictions remain or are not modified, or in lieu thereof some plan devised to counterbalance their defects, such causes must of necessity preclude the successful maintenance of a merchant marine?"

While the above statement may not accurately represent conditions as they exist, there is no doubt that certain provisions of the navigation laws impose a serious handicap upon American ship owners and make it impossible to operate American ships as economically as vessels under foreign flags. If the American merchant marine is to be built up, or successfully maintained, it must be in a position to meet foreign competition on equal terms and not forced to bear unnecessary burdens due to defective and impractical laws. In discussing this matter at the recent shipping conference at Washington the president of the International Mercantile Marine stated that, as far as the laws are concerned, they need certain modifications in order to put an American ship at as little disadvantage as possible the world over.

Some time ago it was understood that the Shipping Board had appointed a committee of prominent shipping men to formulate recommendations for the revision of the navigation laws and it was to be expected that by this time substantial progress would have been made in this direction, but in a recent press despatch it was stated that the members of this committee had not yet been notified of their appointment! Isn't it about time that this vital matter should be thoroughly investigated?

Employment Managers in the Shipyards

THE annual meeting of the Employment Managers' Committee of the Atlantic Coast Shipbuilders' Association, recently held in Atlantic City, was a notable gathering both in attendance and in the importance of the subjects discussed. Until the shipbuilders were confronted with the enormous war shipbuilding programme and the staggering problems involved in the recruiting of labor for this gigantic task there had been little co-operation among the employment departments of the various yards, and each yard was handling its labor problems in its own way, and, in many cases, due to the lack of co-operation, rather inefficiently. But early in 1918 labor was at a premium or practically unavailable. Men were being enticed from one industry to another, and frequently from one shipyard to another with disastrous results. This condition immediately developed the need for co-operation and a better understanding among the shipyard employment department heads, with the result that the Employment Managers' Committee of the Atlantic Coast Shipbuilders' Association was organized as a distinct body with its own officers. The active membership includes thirty-six employment department heads, who were responsible during the latter period of the war emergency for the maintenance of working forces totalling more than 200,000 employes in the shipyards holding membership in the Atlantic Coast Shipbuilders' Association. Associate members are the service managers of the same yards and the employment managers of wooden, concrete, repair and other yards not eligible to membership in the association.

According to the annual report of the secretary, important strides were made in eliminating extravagant and demoralizing scamping among the shipyards, thereby exerting a strong influence in stabilizing the labor supply in the shipyards without removing the wholesome elements of clean-cut competition. A standardized plan of draft procedure was adopted for dealing with employees and ridding the yards of slackers. Other uniform methods were employed to meet the various annoying problems that threatened to impede the shipbuilding programme.

A standard practice of figuring labor turnover and handling employment statistics was adopted, and in one instance several yards formulated a plan for the collective recruiting of labor which brought about satisfactory results. The committee also took an active part in the cataloguing of discharged soldiers at the thirty demobilization camps throughout the country, furnishing information to the employment departments regarding more than 6,000 discharged soldiers who were seeking shipyard work.

It is planned to establish through the association's Philadelphia office a clearing house on information regarding the labor supply whereby any shipyard having a surplus of men in any craft will so notify the secretary and this information will be available for the other yards. An exchange of weeky reports is embodied in the plan.

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Plans for English Channel Train Ferries

LONG before the end of the war, plans had been completed for the installation of an English Channel ferry for the transport of freight and passenger cars between England and France. The interest centered in this project was largely due to the efforts of Michel Mercurio, the Paris banker and organizer of the Societé Française d'Action Economique, under whose leadership there was formed the Societé Centrale des Ferry Boats. As a first step, this company bought the Inter-Continental Railway Company, Ltd., which had perfected rights for the installation of train ferries between Newhaven and Dieppe. Even before the war this project had gained the support of Messrs. Schneider & Company in France and Lord Weardale in England, as well as of Paul Bignon, deputy of Dieppe and president of the Conseil Generale of the Seine Inferieure. Monsieur Bignon is at present president of the Societe des Ferry Boats.

According to Daniel T. Pierce, New York, American representative of the Française d'Action Economique, an intensive study has been made of the opportunities for developing train ferries, both from the engineering and commercial points of view, the Societé Centrale bringing together a consulting council which includes two engineers of the Ministry of Public Works; Luigi Luiggi, of the International Commission of the Suez Canal; representatives of the Chambers of Commerce of London and Paris; Paul Cloarec, vice-president of the Ligue Maritime Française; John Kenneth Foster, of the Great Eastern Railway, London, and others whose engineering, transportation and commercial co-operation has brought together all possible information and wisdom on the problem to be solved.

In the investigation undertaken under the guidance of the Societé Centrale, all past and present train ferries have been thoroughly investigated. The record of these begins in 1852 with the transport of trains on boats across the Firth of Forth and the Firth of Tay. These ferries were in successful operation up to the construction of the famous bridges over these bodies of water. An extensive train traffic is also handled between Denmark and Sweden, one of these lines inaugurated in 1903 being 26 miles in length. The report states that the excellence of this service has been demonstrated over a long period and that the "journey between Copenhagen and Sweden takes place, even for sleeping car passengers, without notice to them that the sea has been crossed." Account is also, of course, taken of the train ferry between Key West and Havana, and the transport of trains on Lake Michigan and Lake Erie, and of the lines between Reggio, Calabra and Messina, Sicily. Of the latter it is said that they "permit the constant passage of train ferries between the Continent and Sicily even in the worst weather." Special stress is laid on the success of the ferry between Sassenitz, Germany, and Trelleborg, Sweden, established in 1909, which covers a distance about equal to that which separates Dieppe from Newhaven.

Some very interesting figures are given as to the increase of traffic brought about by this latter train ferry. In the six-months' period prior to the starting of the ferry, 9,640 passengers and 2,600 tons of merchandise passed between the two points named. In a similar period two years later (July-December, 1911) the Sassenitz-Trelleborg ferry was handling 48,600 passengers and 42,000 tons of freight.

Beginning with the Newhaven-Dieppe ferry, the Societé Centrale has now organized two other undertakings, one of which is known as the North of France and Orient ferry, which has the full co-operation of the International Sleeping Car Company and the approval of the French Government, which has already assured a subsidy for the carrying of mails by this route. By this means trains will be operated without change from England to Brindisi and Constantinople.

A third train ferry project, also mothered by the Societé Centrale, will run between Harwich and Ostend. This latter project has already gained the co-operation of the Great Eastern Railway. In Belgium the Harwich-Ostend ferry is actively supported by Monsieur Paul Siegers, late Minister of Marine, and at present holding another portfolio in the Belgian Government.

All of these undertakings have emerged from the status of mere projects and are going forward to completion far in advance of the more spectacular plans for a channel tunnel, although the next generation will undoubtedly see a tunnel completed between England and France, as all objections to this plan have disappeared as a result of the war.

The specifications on which tenders have been asked from English shipbuilders call for boats of 21 knots speed, the "utilizable" length of rails on the vessels to be 689 feet. This trackage would accommodate 22 freight cars of 20 tons each, or 10 freight cars and a train comprising 7 passenger cars 49 feet 3 inches in length and one luggage van. The draft of the boats is not to exceed 15 feet 9 inches.

In commenting upon the train ferry plans of the Societé Centrale, Monsieur Mercurio justifies them first of all on the ground that "our economic prosperity absolutely depends upon better transportation. It is therefore a patriotic duty to go to work at once and without delay in order to assure revictualling, to reconstitute stocks, to intensify commercial relations—in a word, to realize a policy of extensive, cheap and rapid transportation, useful and profitable both to general and individual interests."

LETTERS TO THE EDITOR

What is the Matter with the Society of Naval Architects and Marine Engineers?

The letter in your issue of July regarding the Society of Naval Architects and Marine Engineers is a very timely one.

There was an informal meeting called in Washington the middle of January by Senator Ransdell and others to discuss the question of organizing what has become the National Merchant Marine Association. So far as I know, no one attended this meeting who in any way whatever represented the society, and in the two-days' talk at the meeting no reference was made to the society.

Late in March another meeting was called to make the temporary organization permanent. At this meeting there was no reference made to the Society of Naval Architects and Marine Engineers, nor was there anybody present who apparently represented the society in any way.

Late in May, Mr. Hurley, chairman of the Shipping Board, called leading men together to discuss merchant marine matters, and, so far as I can learn, no one present represented the Society of Naval Architects and Marine Engineers.

I agree with your correspondent that the society ought to be active in important movements looking toward the upbuilding of the American merchant marine.

ANOTHER MEMBER.

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Electric Drive on Merchant Ships

Will the sweeping statements made by Mr. W. L. R. Emmet in his comparison of electric drive with reduction gearing for merchant ships in your May issue stand examination in the light of all the facts? Some of the facts may be unknown to Mr. Emmet, but that does not render his conclusions any more valid.

He contends, first, that electric drive is practically as efficient as gear drive, and, second, that it is more simple and reliable.

He claims for the electric drive with high-speed turbines and the most improved electrical apparatus a transmission efficiency of 93.5 percent, but says that the efficiency of a smoothly running double-reduction gear equipment in good condition does not exceed 94.5 percent.

Careful tests made by different manufacturers, however, show conclusively that the efficiency of a helical gear reduction, designed on correct principles and with good workmanship, is, if anything, higher than 98.5 percent, and the efficiency of a double-reduction gear should, therefore, be about 97 percent. These figures are corroborated by tests made on a 2,500-horsepower De Laval marine turbine with double gear reduction in actual service. When developing full load, the rise in temperature of the oil passing through the machine did not exceed 10 degrees F. when circulating 75 gallons of oil per minute. The temperatures of gear cases, covers and bearing caps were only a little above the engine room temperature, so that the loss of heat by radiation can be ignored or can be offset against the heat developed in the two main turbine bearings and in the turbine thrust bearings, since the oil from the latter was not separated from that used on the gears. These figures indicate a gear efficiency of 97.7 percent.

Careful tests made in 1909 on the first Melville-Macalpine gear reduction showed an efficiency of 98.75 percent.

A small double helical gear (about 30 horsepower, running at 1,800 revolutions per minute) tested in 1911 gave an efficiency of over 98 percent, as described in *Zeitschrift des Vereines Deutcher Ingenieure*, August 26, 1911. The method used in testing this small gear is of interest and can be applied to larger gears. Two identical gear reductions were connected together by coupling the two pinions and the two gears, respectively. One of these couplings was a specially designed spring coupling, so that known tooth pressures, corresponding to different loads, could be established. The whole was then driven by a small calibrated motor, and by measuring the electrical input to the latter it was possible to determine the amount of energy consumed by the gearing.

There is no reason why the efficiency of ship gears should be lower than that of gears in land service. The foregoing figures show that with properly designed gears it should not be less than 97 percent, and the advantage of double gearing over the electric drive, using the figures claimed by Mr. Emmet for the latter, would thus be over 3½ percent. The advantage of the single reduction gear would be still greater.

Mr. Emmet is unfavorable to single reduction gears and to the division of the turbine into two or more parts, stating that the latter arrangement has increased packing losses and complication. It has several advantages, however, which more than counterbalance the slight disadvantages, for instance:

1. The division of the turbine into two parts makes it possible to obtain better thermal efficiency through being able to use a greater number of stages without extremely long turbine casings with their accompanying troubles from distortion by temperature. More stages give lower steam velocities, less erosion of buckets and lower bucket velocities.

2. A single-screw vessel equipped with compound turbines is always able to proceed at slightly reduced speed with one turbine in case of an accident to either turbine, whereas a single turbine vessel, whether with gear transmission or with electric transmission, would be at the mercy of the sea.

3. The compound turbine gives equal distribution of load through the gear sets, which is a great advantage in connection with double gear reductions. Some of the gear trouble experienced with double gear reductions in connection with single turbines have undoubtedly been due to difficulties in providing sufficient flexibility in the connection between the high-speed gears and the low-speed pinions, since the load distribution cannot be equal unless the alinement between the teeth is far more perfect than it is practically possible to obtain, even by using so-called flexible gears or a flexible shaft passing through a hollow low-speed pinion.

An important fact, not mentioned by Mr. Emmet, is that whereas some manufacturers of gears have had much trouble, others have had little or none. The troubles in the low-speed elements of marine gears, to which he alludes, are easily explained by the fact that certain gear builders apparently believe that their special designs of gears allow the use of considerably higher tooth pressures than have proved to be practical in the extended experience of other builders.

Mr. Emmet states that the principal troubles with marine gears have developed in the low-speed elements of double reduction gears, due, he suggests, to severe shocks and periodic vibrations from the propeller. It is difficult to understand, however, why the low-speed gear of a double reduction gear should have more trouble from this source than single reduction gears, many of which are in satisfactory operation. Properly designed low-speed reductions are very smooth and practically noiseless in operation, which would not be true if shocks or vibrations from the propeller were sufficient to cause excessive wear or breakage of teeth.

Finally, it appears to me that when all of the features and complicated parts of the electric drive are compared with the simplicity of the gear drive, either of the double reduction or single reduction types, the gears are to be preferred, the more so as they effect considerable economies in power, weight and space. Electric drive involves the use of steam turbines, electric generators, electric motors and complicated controlling mechanism, the care of which requires the services of skilled electricians of long training. The significance of this aspect of the matter cannot be escaped in reading the description of the equipment of the United States battleship *New Mexico*, which appears in the same issue with Mr. Emmet's article. The electric transmission equipment of a four-screw battleship developing some 23,000 kilowatts is naturally more extensive and complicated than that of a one- or two-screw cargo steamer requiring only 3,000 to 8,000 horsepower; but, even if the amount of electrical equipment installed on the *New Mexico* be divided by 10, it will still prove staggering to the ordinary marine engineer, and will certainly offer many more possibilities of derangement and mal-function than do the rugged gears of simple design and construction, which have already proved their reliability in both merchant and war vessels.

Trenton, N. J. A. PETERSON,
Engineer, De Laval Steam Turbine Company.

The United States Shipping Board has announced that it has vacancies for 1,500 firemen in the merchant marine.

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Congress Grapples with the Problem of the Establishment of an American Merchant Marine

BY WALDON FAWCETT

HOW to perpetuate and how best to extend and develop the American merchant marine that attained to proud dimensions during the war is one of the most important problems before the 66th Congress of the United States at its first or special session. That not only the significance of the issue, but likewise the need for prompt solution is well recognized in the national legislature, is attested by the fact that the merchant marine question has been placed alongside that of railroad control and regulation of railroad rates for consideration in advance of other features of administrative policy.

It is proverbial that the real work of Congress and the formulation of policies take place in committees, and it is therefore interesting to note what is taking place in the subordinate bodies to which Cngress looks for recommendations as to the legislation that is needed to provide for the future of the merchant marine. In the United States Senate the responsibility for determining the Governmental attitude toward the merchant marine has been entrusted to the Committee on Commerce. In the House of Representatives it is the Committee on the Merchant Marine and Fisheries that is wrestling with the complex problem. These respective committees have inaugurated hearings that will extend over an interval of weeks, and perhaps of months, and embodied in the testimony that is being submitted are not a few points likely to prove of interest to practical men in the shipping and shipbuilding fields.

Foreign Contracts for American Yards

For example, the first question to be raised at these hearings was that of the freedom of American shipbuilders to solicit and accept foreign contracts. Stating his position on this proposition, Chairman Edward N. Hurley, of the Shipping Board, replying to the questions of Senators, said: "I do not think there is any reason why the American shipyards should not have the right to accept bids and negotiate for foreign contracts. We feel that there should be no restrictions on the negotiations between the shipbuilders and foreign buyers, with this exception: We have about $75,000,000 (£15,400,000) worth of shipbuilding materials to salvage, which we are trying to dispose of, and we have felt that we could dispose of that better by co-operating with the American builders. If the American builder closes his contract with a foreign buyer and he has claims against the United States Shipping Board Emergency Fleet Corporation, or whether he has such claims or not, we feel that we should like to have the shipbuilder come in to see us, to ascertain if we can not in a co-operative way dispose of that material, in order to relieve the situation throughout the country, particularly in connection with the manufacturing of boilers, engines and other materials that are now stored in the different warehouses throughout the country. If we do not have, I would not say control, but some method of having a voice in that, I am fearful that we will have a lot of material left on our hands that we might otherwise dispose of through the shipbuilders and the foreign buyers."

It was recognized in the discussion that the interest of a shipbuilder in the engines, boilers, shapes, plates, etc., that the Government is desirous of salvaging is contingent upon his securance, for foreign or domestic account, of contracts for the particular style of ship to which the Government material is adapted. However, a number of Senators who have shipbuilders among their constituents are suspicious that, for all the ostensible lifting by the President of the ban on foreign contracts, undue pressure is yet being brought to bear by the Shipping Board to induce shipbuilders who make private contracts to take over for their operations a share of the Government's "left over" material. There has been considerable cross-examination at the hearings as to the demand of the Shipping Board that it be allowed to *visé* private contracts entered into by shipbuilders with whom it has commitments, and effort has been made to bring out whether the adjustment of the Shipping Board's contracts—a large proportion of which remain to be disposed of—is being delayed for the purpose of bringing pressure to bear upon contractors to take over material that the Government desires to get rid of. At one stage of the examination of Mr. Hurley, the chairman of the Senate Committee asked the head of the Shipping Board: "Is it good policy for the Government to hold up shipbuilding until you can negotiate with the parties to sell to them the salvage which you have on hand?"

Senator Harding raised the question whether it might not be possible in the event that private shipbuilders are not willing to take the salvage off the Government's hands at a reasonable sacrifice to select a Government-controlled shipyard or a yard in which the Government has an equity (other than a fabricating yard) and there mobilize all salvage and utilize it in the construction of ships. Chairman Hurley expressed the opinion that it would be impracticable thus to attempt to use odds and ends in all stages of manufacture that would have to be assembled from shipyards in all parts of the country.

Cost of Shipbuilding Abroad

In answer to inquiries from Senators, Chairman Hurley and other officials of the Shipping Board gave $140 (29/3/4) to $160 (33/6/8) as the present cost of ship construction in Great Britain, with a proviso in each contract that increases in labor costs must be taken care of by the buyer. American shipbuilders who have within the past few weeks bid on foreign contracts were represented as bidding $144 (30/0/0) to $162 (33/15/0) a ton, although Chairman Hurley told of a report, in which he confessedly did not take much stock, of a broker's transaction that contemplated the construction on the Pacific coast of eight steamers of 8,800 tons each at a cost of $135 (28/2/6) a ton.

Under its contracts the Shipping Board has been paying approximately $206 (42/18) per ton, but a special committee of shipbuilders and ship operators appointed some months since to act in an advisory capacity has recommended that contracts for steel steamers of less than 9,000 tons' capacity for completion in 1920 should be can-

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celed in all cases where cancellation can be effected at a basis of approximately $75 (15/12/6) per deadweight ton, "as it is doubtful whether such steamers would have a market value when completed of more than $100 (20/16/8) per ton deadweight capacity."

In the consideration in the Senate committee of war-time shipbuilding costs, considerable stress has been laid upon the fact that the cost to the Government is not adequately represented by that ratio of tonnage to monetary outlay which indicates a cost of $206 (42/18/4) a deadweight ton. Set over against this is the fact that some shipbuilders in this country have paid into the United States Treasury income and excess profit taxes aggregating $40 (8/6/8) a deadweight ton on the vessels they have constructed. Others have paid the equivalent of $30 (6/5/0) a ton, and it has been estimated that in no instance has less than $25 (5/4/2) a deadweight ton been returned to the Treasury in war taxes, this virtual rebate to the Government taking no account of the special taxes paid by sub-contractors. On this theory, Chairman Hurley and his associates estimate that $180 (37/10/0) a deadweight ton the actual cost to the Government of its war-inspired merchant fleet.

Value of Cargo Ships

The present-day value and the prospective value of cargo ships have been a subject of animated discussion throughout the hearings thus far held. At one session Commander Ackerson, U. S. N., of the Shipping Board staff, told of the impression among ship operators that ships are not worth more than $150 (31/5/0) per ton to-day. He made it clear, however, that he did not sympathize with so conservative an appraisal. Asserting his optimism, he declared that he believed a ship is worth more than $200 (41/13/4) a ton to-day, "and will be worth more than $250 (52/1/8) six months from to-day."

For all his confidence, however in the value of ships, present and prospective, the Shipping Board executive was dubious as to the wisdom of investing Government money for the completion of ships now under contract but in the early stages of construction and thus open to discontinuance of operation. Admitting that it would probably cost less to-day to build a ship than the Shipping Board's contracts call for, Commander Ackerson, discussing the proposal to carry out the original programme, said: "While this money is an emergency fund, I did not feel that we were justified in taking the possible risk that we would take if we were business men with this money at our disposal for our own profit or loss. That would be a different thing. If I had all this money I would not be a bit afraid to do it."

A Hitch in Re-adjusting Contracts

The spokesman for the Shipping Board conveyed the impression that shipbuilders holding contracts with the Government have not responded as promptly and adequately as might be wished to requests from Washington for information as to the exact status of each ship upon which work was ordered suspended after the signing of the armistice, the desire of the officials being to have this information in hand as a basis for determining whether the respective contracts should be adjusted and canceled or carried out as originally contemplated. That the Federal shipbuilding directors have all along had in mind the possibility that Congress would elect to complete the shipbuilding programme and dispose of the ships in the open market or otherwise was attested by the letter which Chairman Hurley sent to all contracting shipbuilders under date of May 12, 1919—six months after the signing of the armistice—in which he called attention to the fact that existing appropriations for shipbuilding would be exhausted by July 15, and suggested that shipbuilders revise their contracts, adapting them to present conditions of material and labor costs and naming a new flat price on all contracts entered into on the cost-plus basis, so that Congress, if disposed to carry through the uncompleted programme or any portion of it, would be in possession of information as to the exact cost.

Substitution of New Types of Vessels

In the quiz in the Senate Committee, Senator Jones and other Senators endeavored, but without conspicuous success, to wring from Chairman Hurley confession that the suspensions of shipbuilding contracts that have been made (where suspension is not equivalent to cancellation) have been ordered with the idea of the substitution of new types of ships. Mr. Hurley admitted that the Shipping Board "had substitutions in mind" but insisted it did not suspend for that purpose solely. He added that there were few yards in the country that could construct the large types of ships that would be contemplated in substitution.

Throughout the hearings there has been manifest a conviction on the part of the Shipping Board officials that the Government has an ill-balanced fleet and one not adapted to post-war conditions,—is, in fact, overstocked with smaller ships and with vessels of a speed of only 8½ to 9½ knots, in contrast to the steamers of higher speed demanded by current conditions. This is, of course, in line with the recommendations of the committee of shipbuilders and ship operators which, while counseling the completion of all steel steamers of over 9,000 tons, declared specifically, as a matter of future policy, for the construction of the larger type, shelter deck, cargo steamers of 11,000 to about 15,000 tons total deadweight capacity and capable of maintaining a sea speed of at least 12 knots. Chairman Hurley, in one of his conferences with the Senate Committee, declared: "We need seventy-four or a hundred 12,500-ton ships." He had also, he indicated, come around to the way of thinking of the shipbuilders and ship operators that the Government has been building entirely too many vessels of less than 5,000 tons. The advisers in the industry recommended that the Government sell approximately one-half of the steamers of a capacity of 5,000 tons or under, selling with the right to transfer flag, but Mr. Hurley in his latest expressions at the Capitol has voiced doubt whether it will be possible to sell advantageously all these smaller and slower ships which, as he put it, "cannot compete with our competitors on the other side."

Rosseter Favors Reinstatement of Contracts

The problem of substitution and kindred questions has been discussed at length with the Senate Committee by J. H. Rosseter, Director of Operations of the Emergency Fleet Corporation. Mr. Rosseter's qualification for rendering judgment on these considerations arises in the main part out of his recent experience in the organization of the operation of the ships owned by the Shipping Board,—the direction of trades, fixing of freight rates, manning of the ships, etc.—Mr. Rosseter has, in the interest of the maintenance of the shipbuilding industry, urged, from the time that the question arose with the signing of the armistice, that in so far as possible the suspension of contracts should be made with reference to reinstatement.

Outlining the evolution of the policy of re-alinement in ship construction which has been worked out in the Shipping Board to meet post-war conditions, Director Rosseter explained that as early as February of this year

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his division had prepared tentative plans for four new types of ships for service on the Pacific,—namely, a 10,000-ton ship, a 12,000-ton type, a 15,000-ton type, and a special type with internal combustion engines. His eagerness to have American shipbuilding effort shift to the production of the most efficient and economical type of ship is ascribed to the belief that a successful American merchant marine will be practicable only if "we have the right instruments to survive the dull times of shipping." Detailing another step in the "rearrangement" of the fleet, Mr. Rosseter pointed out how 154 coal-burning steamers under construction or under contract in Great Lakes yards have been changed to oil burners, with a consequent increase of one-third in steaming radius and a gain in cargo space.

Picturing the complications that necessitated quick rearrangement of the shipbuilding programme after the cessation of fighting, the Director of Operations said: "First, our ships were built in too large numbers. We had an excess of wooden ships and we had an excessive number of small ships, so-called lake type. The next great factor is the matter of making speed. We, of course, have made no provision at all for fixed freight and passenger ships, so-called liners, and practically no provision at all for a ship of partial refrigeration. We have four refrigerator ships, but no partial refrigerator ships. Many of these changes could be made very easily. Some of them are more difficult. Where we asked for types of propulsion that are not economic, it was a rather serious thing, itself, because the engines had already been contracted for or we had been obligated under a definite contract, and the work had proceeded so far that suspension was difficult to figure; but in all of these instances we tried to approach it from a standpoint of not interfering with the yard and to have a type of ship that would be fairly interchangeable, in the main, in its principal parts."

OPERATING COSTS IN THE AMERICAN MERCHANT MARINE

Discussing at one point in his testimony the relation of shipbuilding to operating costs in the American merchant marine and the chance for American shipping to hold its own in world-wide competition, this specialist said significantly: "Our ships must be built on a basis no higher than and, if possible, not as high as those of our competitors. We will win when we can get down to a cheaper basis, and that is one of the reasons why I have been so insistent in this matter of cost. We can build ships as cheaply as they can be built abroad. I have visited every large shipyard in the world. That is a broad statement, but it is true—Japan and China, as well as Germany and England and the United States. I have had some experience with shipbuilding, and I am absolutely convinced, and I will also confess that my wish probably strengthens me in that conclusion, that unless we can build the ships as cheaply as anyone else, when we have to pay more for seamen, we are bound to fail. One by one the larger shipbuilders come to me and tell me they believe I am right."

In answer to questions, Mr. Rosseter endorsed, in effect, what had been said by other practical men who have appeared before the Congressional committees as to the difficulty of ascertaining on what price basis British shipbuilders have been taking contracts since the signing of the armistice. He said that he had information from a source that he believed to be authentic to the effect that one British shipbuilding firm has taken a contract for a straight cargo ship at a rate of approximately $137 (28/10/10) a ton. On the other hand, he had heard of contracts on a basis of 55 pounds sterling ($260) per ton, which is, of course, considerably more than the cost of construction in the United States. Emphasis was laid in this connection, however, that it is not so much British competition that the American shipbuilders must face, but Japanese shipbuilding, in which latter industry, Mr. Rosseter pointed out, there is considerable construction at a rate of $50 (10/8/4) per ton below the United States cost.

For all that Mr. Rosseter subscribes in a general way to the leaning to larger ships, he does not want to overdo it, and has a good word to say for what is known as the Hog Island type of ship. In elaboration of the theory that "you do not want too many large ships" and that the 7,500-ton ships must be taken into account in the balance of the mercantile fleet, he called attention to the record of the British firm that built a fleet of 31 ships of 7,200 tons which came, in time, to have a reputation all over the world as "the most available for any trade." Regardless of size of ship, however, the desire on the part of the Shipping Board is to obtain higher speed. Speaking to this text, Mr. Rosseter said: "The old custom of building a ship of eight or nine knots, a tramp ship, has been gradually passing into the background. Therefore, we want to come from the rear to the front in the matter of speed, at a reasonable cost for the accomplishment of speed. Increased speed may be accomplished very easily up to 12½ knots."

THE CASE OF THE PACIFIC COAST SHIPBUILDERS

Shipbuilders on the Pacific Coast have been represented at the hearings by Harrison S. Robinson, of Oakland, Cal., who has stated that for most of the yards on the west coast the situation is one that will involve their life or death during the next few months. Skepticism has been expressed that the basis of contract cancellation contemplated by the Shipping Board does not afford adequate reimbursement to the shipbuilders, and the earnest plea put forth that the "chopping off" of Government contracts be done in such manner as to "enable the yards to tie on to the end of their Government programme the beginning of their private programme."

It is the contention of the Pacific Coast shipbuilders that there is no need for drastic or precipitate action because there is an undoubted market for such tonnage as would have to be built to Government contract to enable the yards to bridge the gap and continue moral activity up to the point where Government work could be replaced by private operations. Furthermore, it is urged that the Government should pursue no course that would not amount to a determination by the Government which yards shall survive and which shall cease operation, but that, instead, all of the yards should have a chance at a running start to continue business.

President H. A. Evans, of the Baltimore Dry Docks and Shipbuilding Company, is the only Eastern shipbuilder to testify thus far before the committee. He stated that the position of this company was not as serious as that of some of the Pacific Coast plants, but that unless the Shipping Board authorized, within thirty days, the continuance of work on contracts in hand, it would be necessary to begin to lay off men. Mr. Evans explained the tardiness of response of which Shipping Board officials complained by stating that shipbuilders have found it a most tedious proceeding to obtain from their subcontractors—running into hundreds in number—statements as to the terms on which contracts could be cancelled or adjusted. Some of the subcontractors, it was pointed out, are declining absolutely any form of compromise, and assert an intention to hold shipbuilders to the terms of original contracts.

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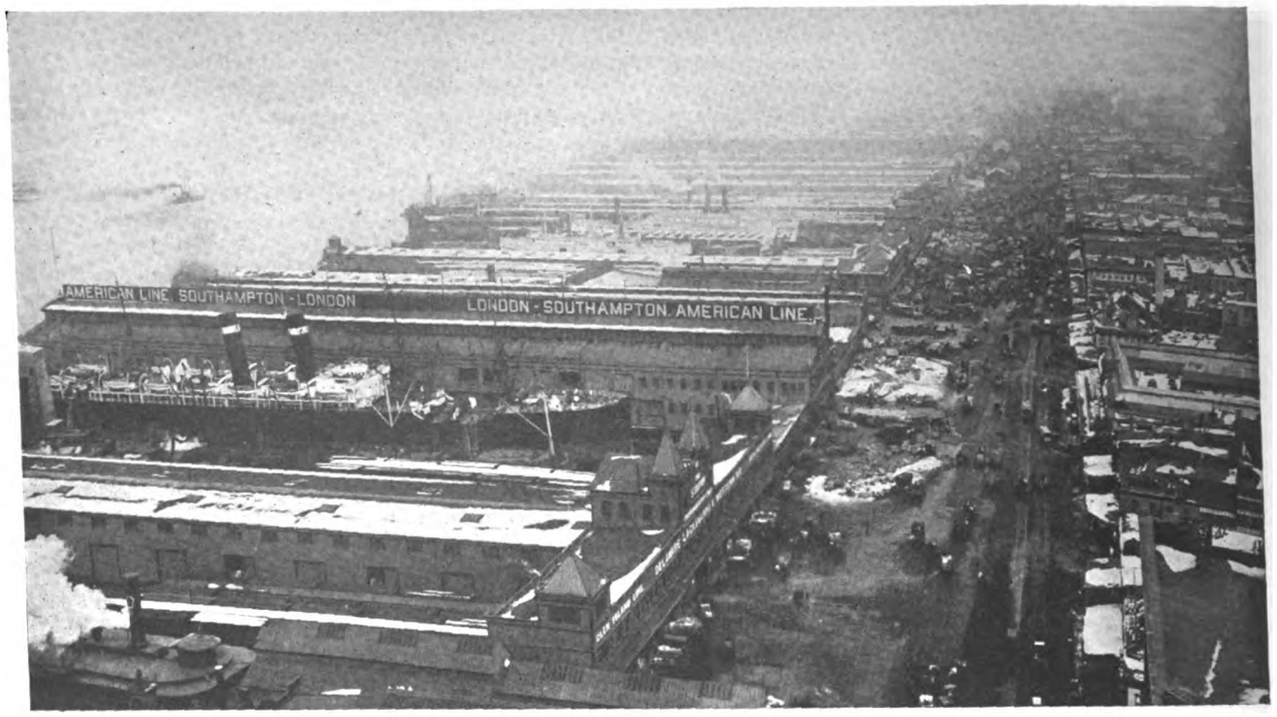

Fig. 1.—West Street New York. Fifty Millions Are Spent Annually in Handling Freight Within the Corporate Limits of New York City, of Which More Than Half Is Expended at Marine Terminals

Motor Trucks and the Problem of Efficient Marine Freight Terminal Operation—I

BY MERRILL C. HORINE

This series of articles will deal specifically with the adequate use of motor trucks as freight terminal carriers. In clearing the ground, however, for this subject, the author has drawn from his wide experience in the complex phases of economical terminal operation, so that the paper is, in a sense, a complete survey of the terminal operation field. Mr. Horine discusses in this first instalment the inter-relation of carriers—railroads, transfer drays and steamships—with piers and warehouses; he takes up the problem of centralized control at terminal points to cover the overlapping functions of these agents; he analyzes carefully the special functions of the pier and warehouse, taking a fling at the antiquated American custom which permits the stoppage of traffic by allowing free time privilege on piers before he swings into a discussion upon vehicular service which bears directly upon the use of the motor truck in this work.

—THE EDITOR.

MARITIME supremacy will not be won for America on the high seas alone. Building ships, deepening harbors, training personnel and extending the market for American products will be in vain unless transportation on the land is properly wedded to that on the sea. The marine terminal is the neck of the bottle out of which must pass our exports and through which our imports must come.

World trade competition is a matter of quality and price. Manufactured goods must be the mainstay of our export trade, although it costs us more to manufacture, for materials, labor and land, than any other first-class power. Trade in raw materials is largely a matter of cost of transportation, since transportation is the greatest cost in dealing in crude stuffs. We must reduce transportation costs in spite of the fact that it costs more to operate an American merchantman than one under any other flag. Costs can be reduced where there is greatest waste, and to effect substantial reductions in the total requires marked decreases in the largest proportionate items.

Not on the sea, but on the land, the greatest expenses are incurred, and it is here that the most appalling waste is found. Yankee seafarers in the navy and the merchant marine acknowledge no superiors, but our marine freight terminals are the poorest in the world. To carry on an extensive ocean commerce we must be able to keep our ships moving so that their operation may be more economical. We must load and unload them quickly. To effect this and to reduce the staggering terminal charges, we must operate our marine terminals more economically. It is a fortunate economic circumstance that operations which are sped up are usually performed more cheaply. The slowest way is usually the least effective and the most extravagant.

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Nearly everything that is shipped out of the country and brought into it by water has also to be transported by land for considerable distances. The export problem is more than water transportation; economies in contributing land transportation are quite as important as in water transportation.

It costs as much to deliver a shipment from a railroad freight terminal in the New York district to the hold of a ship as it does to transport it by rail from Chicago to the New York freight terminal. The 1,300-mile marine haul from Havana to Boston is cheaper than the transfer from one pier in Boston harbor to another. A bale of cotton may be shipped by water from Savannah to New York at less cost than it can be raised from the hold of the vessel and transferred to a Brooklyn warehouse.

The average railway freight haul in this country is about 250 miles. At this average haul the terminal charges are about equal to the freight tariff—75 cents (3/1½) average.

Antiquated, slow and expensive as much of the ship-unloading is, the excessive terminal charges for marine transportation cannot be laid to this cause. Handling a cargo between the point of origin or destination and the side of the ship costs about fifteen times what it does to load or unload the ship. This cost is in haulage over streets and roads, trucking over platforms and through buildings, weighing, checking, rechecking, loading and unloading into vehicles and platform trucks.

> "One reason why our exports have not aggregated greater tonnage in the past is that it has been impossible for our railroads to deliver adequate freight to the seaboard. A recent compilation of records of 2,000 freight cars on 144 railroads showed the average daily mileage of 26 miles covered in two and one-half hours, giving a moving factor of about 10 percent and representing but little improvement in speed over the stage of Colonial times. On the other hand, railroads are affected by marine terminal traffic as well, and it is entirely reasonable to suppose that an improvement in ship-unloading arrangements saving only two and one-quarter hours a day would approximately double the effectiveness of the railroads and thereby enable them to handle twice the present daily volume of freight."—MERRILL C. HORINE.

MARINE FREIGHT TERMINALS AT FAULT

The fault lies fundamentally in the lack of proper correlation between (a) the steamship, (b) the railroad, and (c) vehicular traffic, which is to say that the marine freight terminal, the natural junction of these three, does not fulfill its mission properly. In many instances the steamship, the pier, the warehouse, the railroad and the trucking interests are independent units. No one interest is responsible for the terminal facilities. Viewing the situation narrowly, each interest performs its particular function as nearly independently as possible, adapting itself to conditions and charging accordingly for its service. Each agent realizes to some extent to what degree its operations are limited by conditions beyond its control and beyond the control of any one interest, and, accordingly, would regard with the utmost favor a co-operative effort to eradicate the many

Fig. 2.—Bush Terminal, Brooklyn, N. Y. The Warehouse Has Been More or Less Neglected as an Important Factor in Marine Freight Terminals. It Is True That a Few, Such as Bush Terminal, Have Been Provided with Warehouses Back of the Bulkheads, But These Are Not an Integral Part of the Terminal, Nor Do They Act as Clearing Houses for Freight

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Fig. 3.—West Shore Railroad Terminal, Weehawken, N. J. Improvement in Ship-Unloading Arrangements Saving Only 2¼ Hours a Day Would Approximately Double the Effectiveness of the Railroads and Would Eliminate the Congestion at Railroad Terminals Which So Hampers Expeditious Exchange of Marine Cargoes

evils which have been allowed to grow through the perpetuation of antiquated equipment, methods and relations.

Nor can the transportation interests unaided solve this difficulty. It is a situation affecting and affected by every element of foreign commerce. If the importers and exporters of this country, looking forward to successful competition in world trade, had any conception of the almost hopeless inefficiency of freight movement at our ports, or if they could realize how enthusiastically shipowners, terminal operators and carriers would welcome their awakening to the necessity of improvement, American travelers could look upon such ports as Hamburg and Rotterdam without blushing for New York.

Stringent Regulation of Terminal Conditions Needed

As long as any American shipper or receiver of freight is allowed the excessive free time at terminals which he now takes, as long as any merchant can use a steamship pier for a warehouse at bargain rates, and as long as any private vehicle is allowed undisputed access to any terminal at its owner's pleasure, just so long will every user of transportation demand these privileges. Under these conditions efficient operation of the terminals is impossible.

The first railroads in this country were merely railed roads on which any shipper might operate his own flange-wheel wagons for the payment of toll. The present low freight charges, averaging 3 mills per ton-mile, are possible through centralizing operation and control of railroad rolling stock—the establishment of a monopoly on the right of way, if you please.

Similarly terminals will become efficient only when they are properly equipped and controlled as ship-unloading and loading appliances. They cannot be successfully operated so long as they are merely piers for ships to tie to or wharves upon which shippers may dump their cargoes.

One reason for the inefficiency of American marine terminals is the fact that their construction has been regarded as a purely architectural matter. More efficient facilities would be provided if engineers of economics were given an opportunity to work on them. American piers are too narrow, as a rule; they hold about a third of a shipload; they rarely have direct railroad facilities. They do not even provide means for getting the goods to vehicles, but are built with the idea that the vehicle will go to the goods—and, at that, make no provision for the efficient movement of vehicles on and off the piers without obstruction.

> "Is it any wonder that motor trucks cannot work effectively under present conditions when, at $2 (8/4) standing cost, for example, the average vehicle is obliged to wait from 2½ to 3½ hours for a chance to load at a marine terminal and only slightly less time to unload? Cases are common where a vehicle must wait in line for as long as two days to unload l.c.l. export freight. Last winter the lines were so long that teamsters, in order to keep their places in line, unhitched their horses and led them to the stables overnight, resuming the long vigil in the morning, and sometimes on a third day."—MERRILL C. HORINE.

Possibility of Reducing Expense at Terminals

One-third of the gross tonnage transported by rail in the United States is either shipped overseas from the rail destination or originates as overseas imports. Fifty millions (£10,250,000) are spent in handling freight within the corporate limits of New York city alone. This amount does not include that part of the port of New York which is on the New Jersey side. Here is our biggest waste. It now costs on an average of 37 cents (1/6½) per ton to handle marine freight at New York. If this charge could be reduced 5 cents (0/2½) per ton by more efficient methods, shippers would save well over $3,000,000 (£615,000) a year.

But it would mean more than this. Wherever costs are reduced by quicker and simpler operations, the volume of business possible with the same facilities is increased, often in greater proportion, and the profits thereby multiplied. There is no question but that American port facilities are susceptible of being greatly increased in capacity. New York habor averages 150 tons of cargo per annum per foot of bulkhead or pier. Marseilles, for

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example, averages 500 tons. On this basis the present terminal facilities at New York would be adequate for three and a half times the tonnage now handled if operations could be sufficiently expedited.

Efficient Terminals Increase Shipowners' Profits

These facts should be sufficient to convince shippers of the paramount importance of improving marine freight terminals, but this is not the only advantage to be derived. Vast economy and greatly increased earnings for shipowners are involved, since such an acceleration of loading and unloading operations would mean less idle ship time in port. It costs about $1,000 (£205) a day to hold an average coastwise or tramp steamer in port, and about $3,000 (£615) a day for an ocean freighter. There is no reason why ships in Atlantic trade should require twelve weeks per round trip, when their engines are capable of driving them across in half this time with reasonable time in port to take on and discharge cargo.

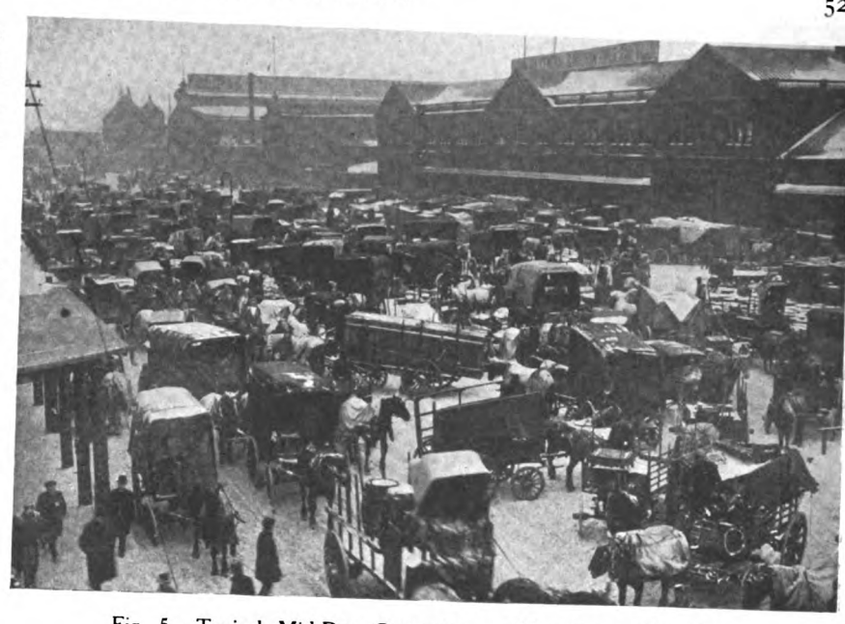

Fig. 5.—Typical Mid-Day Congestion on West Street, New York

Just as slow unloading of ships impedes railroad traffic, so slow railroad traffic impedes ship movement. The moving factor for railroads is even lower than that for steamships. A recent compilation of records of 2,000 freight cars on 144 railroad lines showed the average daily mileage to be 26, covered in 2½ hours, giving a moving factor of about 10 percent and representing but little improvement in speed over the stage of Colonial times. One reason why our exports have not aggregated greater tonnages in the past is that it has been impossible for our railroads to deliver adequate freight to the seaboard. We were rudely awakened to the situation by the war. Since the railroads, on the other hand, are affected by marine traffic, it is entirely reasonable to suppose that an improvement in ship-unloading arrangements saving only 2¼ hours a day would approximately double the effectiveness of the railroads and thereby enable them to handle twice the present daily volume of freight.

Proper Functions of a Pier

To effect this saving through the acceleration of freight movement through the terminals, it is a fundamental necessity that the proper function of the steamship pier be recognized clearly and that its use be permitted exclusively for this purpose. The mission of the pier is to serve as a berth for the vessel and as a platform upon which the vessel may discharge its cargo or from which it may take its cargo.

Under ideal conditions, a ship, immediately upon arrival in port, should be able to warp to a clear bulkhead and discharge its load at once. If possible, such a pier should be large enough to take the entire cargo. If this is impossible, arrangements should be such that the unloaded

Fig. 4.—The Average Vehicle is Obliged to Wait from 2½ to 3½ Hours for a Chance to Load or Unload. Cases Are Common Where a Vehicle Must Wait in Line for as Long as 2 Days

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freight could be removed from the deck as fast as it is raised from the ship's hold. Even where the pier is large enough to receive an entire cargo it should be possible to clear it at approximately the same speed at which the ship unloads, so that as soon as one ship has discharged its load another may take its place and commence unloading.

By the time the ship is emptied, an outbound cargo should be assembled on another pier, so that reloading can be begun immediately. Simultaneously with one or both of these operations, the ship may refuel from lighters, so that its stay in port is limited to the time necessary to discharge and take on cargoes.

This covers the terminal problem from the standpoint of the steamship company. It is natural, therefore, that shipowners should be favorable to improvement in terminal efficiency. Even though the cost of docking be increased considerably to cover the cost of improved equipment, the ship operator would save because his ship would not be eating up the profits in useless riding at anchor while waiting for a load.

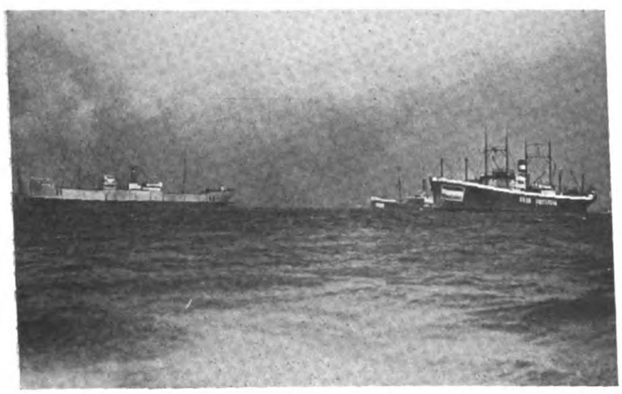

Fig. 6.—Transatlantic Freighters at Anchor in the Upper Bay, New York Harbor. It Costs $3,000 a Day to Keep These Ships Waiting for Cargoes

The shipper, too, would benefit. To him it would mean quicker receipt and shipment of goods; and if an improved scheme of terminal operation meant lower terminal charges, rates might be cheaper. Certainly it would mean quicker dispatch of goods, since he would not have to wait so long for shipping bottoms, and a saving in storage.

Though the terminal operator would by this means collect his berthing charge for shorter periods per ship, he could accommodate more ships, would be warranted in making a higher docking charge, and would be able to handle a greater volume of freight. The latter gain would also entail an increased volume of goods warehoused with the possibility of charging lower rates without loss.

Free Time Privilege Halts Improvements

But there are obstacles. Chiefest of these is the free time evil. Established in the easy-going days when a day more or less in port meant nothing to the shipmaster, and when cargoes often were not sold until they had been unloaded from the ship, the practice of allowing goods to remain on the bulkhead for two days after unloading without charge is to-day the Gordian knot which the shipper cannot hope to unravel. Sooner or later a stalwart Alexander will free the terminals from their fetters by cutting this knot, and it is useless to talk terminal efficiency until that step is taken.

This does not mean that the consignee must receive his goods the hour they are unloaded, but it means that the service of the transportation company will not end when the goods have been set on dry land. It means that whatever free time is allowed will be in bonded warehouses contiguous to the wharves and to which freight will be transferred automatically by the steamship or terminal company.

Control of Demurrage and Warehouse Rates

In Philadelphia a plan whereby free time was reduced and freight segregated by the carriers was successful to the extent of increasing the freight volume 20 to 40 percent with the same force of men at some of the railroad car-float piers. Low demurrage rates are also contributory to slow movement of freight over the terminals, since, in many instances, demurrage costs the receiver less than short-term storage. With higher demurrage and lower warehouse rates for short time, goods can be made to move away from the wharves more quickly.

Function of the Warehouse

The warehouse has been more or less neglected as an important factor in marine freight terminals. The warehouse is the natural reservoir and balancer of the terminal. At peak-load periods, when freight is being received faster than it can be forwarded or is coming faster than it can be delivered, there should be a part of the terminal group in which the goods can accumulate until a low period. The warehouse, therefore, acts either to keep outbound ships supplied with cargoes when receipts are light or to supply the needed imports to the country when shipping is dull.

The warehouse is the logical place for vehicles to load and unload, and not the pier. Most of our New York piers are without warehouse facilities other than their pier sheds. Consequently, the only way in which a pier can be cleared for a new cargo is to induce shippers to come and get their goods. On the other hand, outbound shipments received early must stand in everyone's way until a ship is ready to load them.

Adaptability of Various Pier Arrangements

Several arrangements of the warehouse in relation to the pier are possible. Any of these can be made to provide the proper traffic room for trucks to operate efficiently. The European quay system has many advantages. With this arrangement the ship berths broadside to the land, and the freight may move across the quay over an exceedingly wide space to a parallel warehouse or to streets between warehouses.

The American arrangement of wide piers up to a thousand feet in length can be used in connection with warehouses on the land, provided an unobstructed traffic way is left to give two lines of traffic between the pier and the warehouse.

A pier of sufficient width, say 300 feet or more—with railroad tracks and roadways down its center, may be built up to a mile in length and several stories high, so that commodious loading platforms may be provided on the pier itself, on a different level from the main loading floor, with the warehouse occupying the upper floors. The gigantic recreation pier in Chicago is of this type. As a freight terminal, the structure would accommodate several of the largest-sized ocean steamships at one time, whole trains of cars, and would afford platform facilities for hundreds of trucks to load at once.

Handling Package Freight

Approximately a sixth of the gross tonnage transported by rail is what is termed in railroad parlance l.c.l.,

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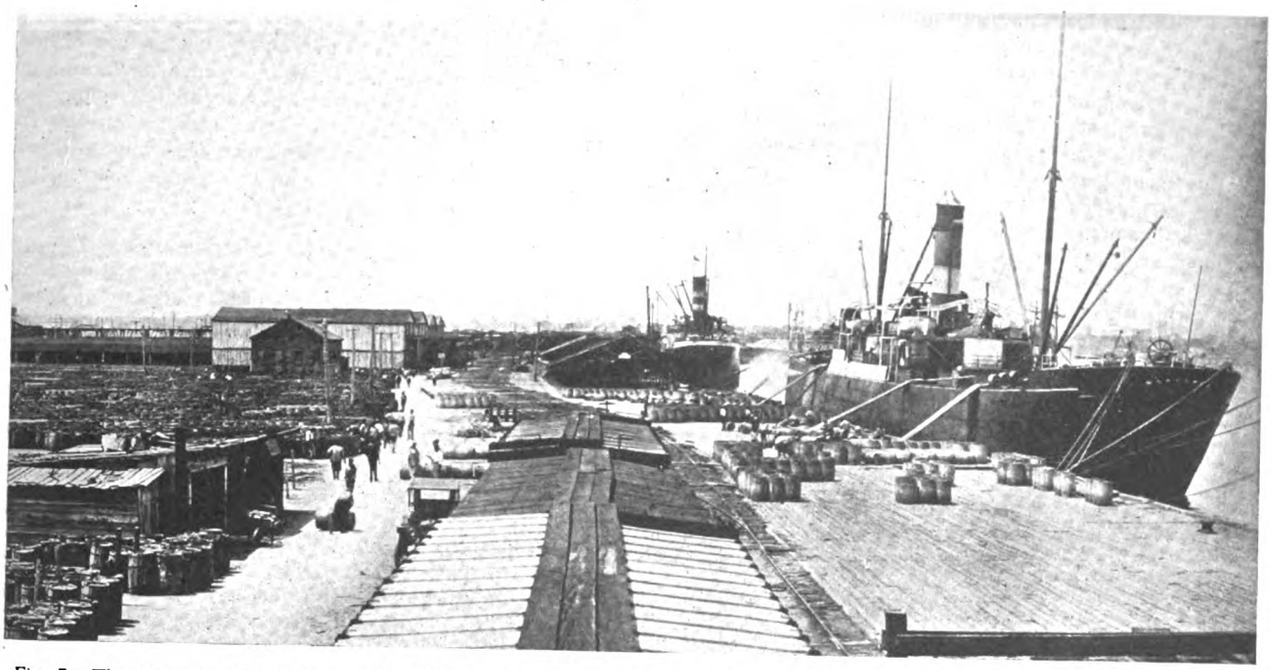

Fig. 7.—The European Quay System Has Many Advantages. Here Is Its Adaptation at the First Naval Stores Port in the World—Savannah, Ga.

or package freight. In all it has been estimated that 600,000,000 tons move across the marine freight terminals annually, exclusive of bulk shipments. Furthermore, the importance of package freight is not to be judged by the volume it assumes in proportion to the total tonnage, since the most valuable cargoes are usually of package freight and bulk shipments are ordinarily of crude materials which have a comparatively low tonnage value.

The trucking and transfer companies which move the bulk of the l.c.l. freight away from the terminals are to be considered in this connection. By horse vehicles or motor trucks these agents transfer freight from terminals to warehouses, and make final deliveries from the terminals and contiguous warehouses to the store doors of merchants.

At present, terminal efficiency means little to these interests because, whether they are able to haul large or small tonnages per vehicle-day, they exact a fee permitting a reasonable profit. Were the terminals so arranged that they might leave or secure loads directly, without waiting, shippers could and undoubtedly would employ motor trucks economically; but so long as present conditions prevail they will continue principally to use horse transportation, which can be operated at minimum overhead expense.

Some idea of the confusion, complication and hopelessness of attempting efficient vehicular movement of freight from New York terminals may be gained from the fact that trucking in New York is done by over a thousand different concerns, aside from mercantile concerns operating their own vehicles.

"It costs as much to deliver a shipment from a railroad freight terminal in the New York district to the hold of a ship as it does to transport it by rail from Chicago to the New York freight terminal. The 1,300-mile marine haul from Havana to Boston is cheaper than the transfer from one pier in Boston harbor to another. A bale of cotton may be shipped by water from Savannah to New York at less cost than it can be raised from the hold of the vessel and transferred to a Brooklyn warehouse.

"The average railway freight haul in this country is about 250 miles. At this average haul the terminal charges are about equal to the freight tariff—75 cents (3/1½) average.

"Antiquated, slow and expensive as much of the ship-unloading is, the excessive terminal charges for marine transportation cannot be laid to this cause. Handling a cargo between the point of origin or destination and the side of the ship costs about fifteen times what it does to load or unload the ship. This cost is in haulage over streets and roads, trucking over platforms and through buildings, weighing, checking, rechecking, loading and unloading into vehicles and platform trucks."

—Merrill C. Horine.

Inefficiency of Present Vehicular Service

Much of the clerical delay and cost, which is one of the most vexing obstacles to efficient terminal operation, is occasioned by this heterogeneity of vehicles and the impossibility of controlling it. It is this condition which is also responsible for the appallingly low load factor prevailing in terminal trucking. Few realize the tremendous waste which this low load factor represents.

Investigations preceding the perfection of the store door delivery project in New York showed that about 2,000 carloads of freight are received daily. During the period observed, at three piers alone 1,100 vehicles arrived to pick up goods for delivery to New York consignees. Ninety-one percent came to the piers empty and the average load taken away was 57 percent of the respective capacities of the vehicles. These 1,100 vehicles could have delivered 2,200 tons, but they actually delivered but 182, yet to have delivered the lost 2,018 tons would have cost practically nothing more, and with efficient arrangement for loading and the elimination of excessive clerical delays the

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entire transfer of this tonnage could have been performed in less time than was absolutely lost by the long waiting in line for a chance to get on the piers.

Is it any wonder that motor trucks cannot work effectively under present conditions when, at $2 (8/4) an hour standing cost, for example, the average vehicle is obliged to wait from 2½ to 3½ hours for a chance to load at a marine terminal and only slightly less time to unload! Cases are common where a vehicle must wait in line for as long as two days to unload l.c.l. export freight. Last winter in New York some of the lines were so long that teamsters, in order to keep their places in line, unhitched their horses and led them to their stables overnight, resuming the long vigil the next day, and sometimes on a third day.

Investigations of the Highways Transport Committee have shown that in New York the average time for loading and unloading a vehicle at a marine terminal is 3 hours; the average load is slightly less than 1 ton. Cases have been cited in which at some of the largest and most famous of New York's newer terminals 11 hours have been consumed in loading one truck.

(*To be continued.*)

Ship Repaired in Record Time

AFTER having her rudder and rudder post carried away in a storm while crossing the Pacific, the *Yomei Maru*, owned by the Ocean Transport Company of Japan, was repaired in record time by the Skinner & Eddy Corporation, of Seattle. The ship was repaired in 20 days.

The *Yomei Maru* was docked at the Skinner & Eddy yard the morning of May 30. The work of backing out the rivets in five stern plates was immediately commenced and the plates removed, the stern frame taken out, and the propeller and tail shaft also removed. This work was completed the following day in twenty-nine hours. After being sealed the ship was undocked.

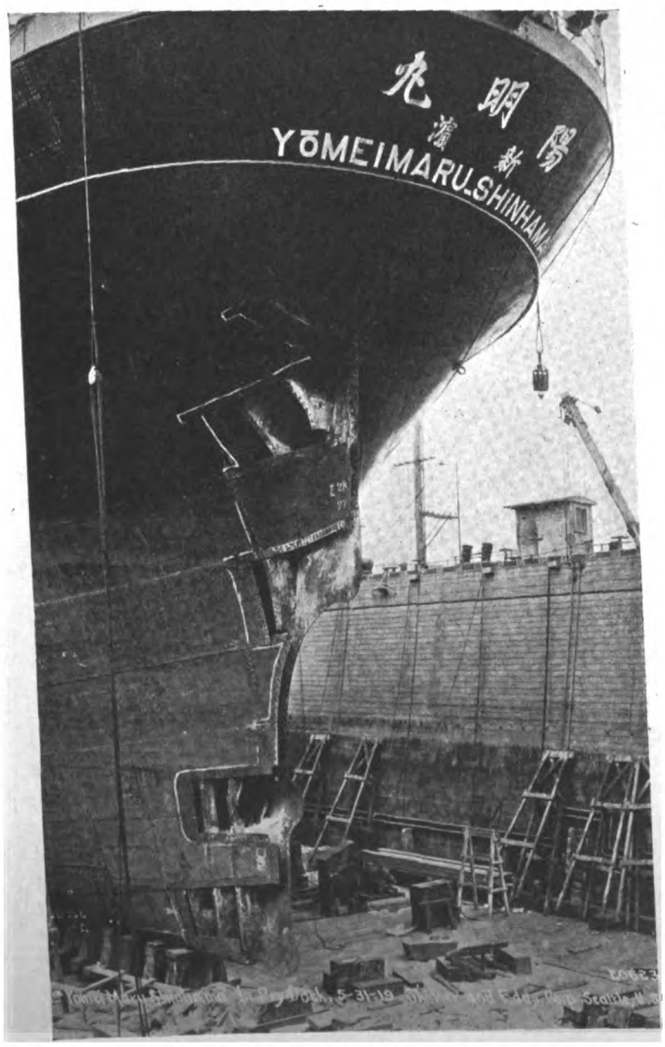
Stern Frame Installed

At the outset of this dismantling work it was necessary for the men to cut through a great thickness of cement in the after peak tank, in order to get at the rivets.

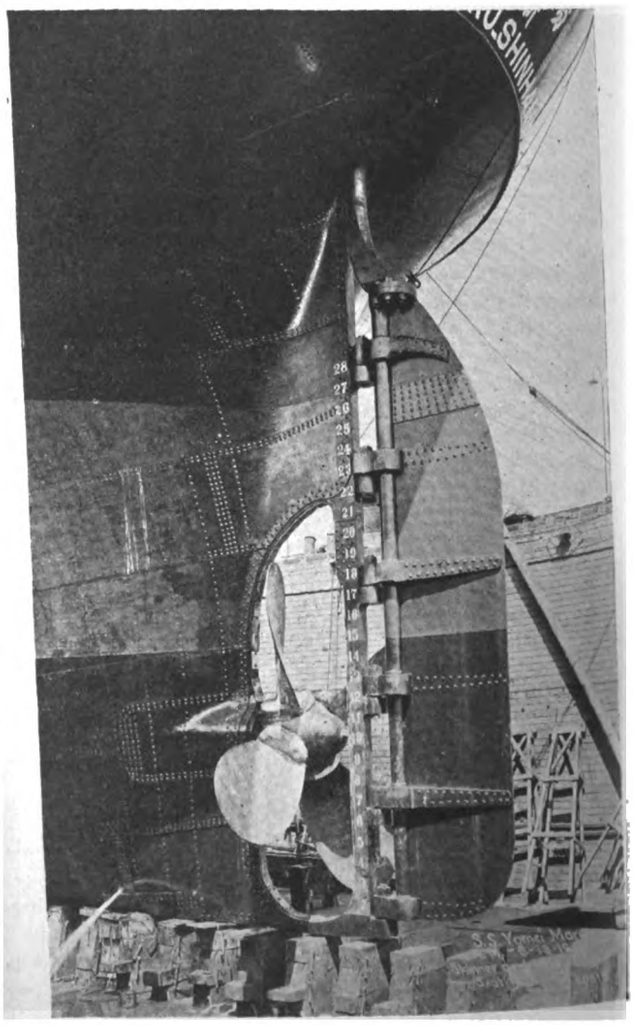
In the meantime, the East Waterway plant of the Pacific Coast & Engineering Company, the largest heavy forging plant west of Pittsburgh, had started on the new stern frame and rudder post forgings. On the morning of June 13 these were delivered at the yards, and the ship was again docked for their installation.

On June 14, the stern frame was in place, and the new plates ready for riveting. The stern frame was then bored for the tail shaft and the rudder and the propeller shipped. All that remained was the final test of the after tanks, after which the ship was floated and returned to commission.

The extent of the repairs may be understood from the size of the rudder, which is 32 feet long, 5 feet wide, and, including its fittings, weighs about 10 tons. The stern frame weighs 20½ tons.



Stern Frame and Plates Cut Away



Repairs Completed in 20 Days

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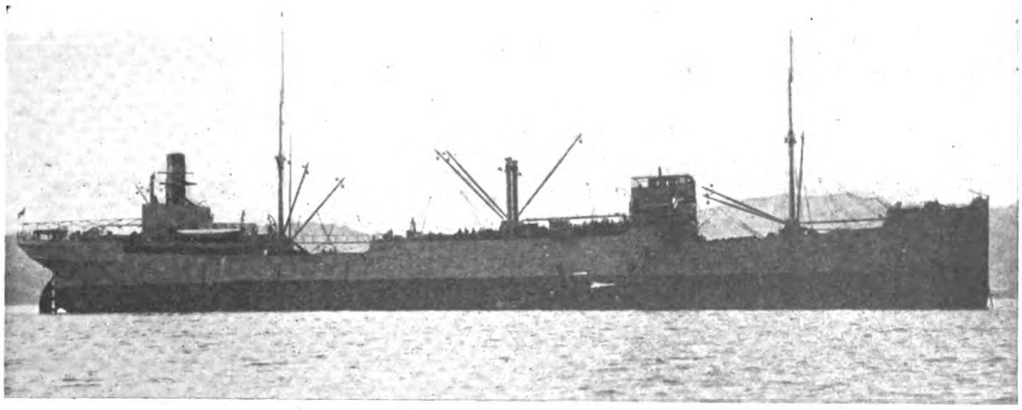

Fig. 1.—Motorship *Ansaldo San Giorgio I*

Italian Motorship Ansaldo San Giorgio I

Description of Cargo Motorship of 8,100 Tons Deadweight Built and Engined by the Ansaldo San Giorgio Company of Italy

BY ARTHUR BENINGTON

THE motorship *Ansaldo San Giorgio I,* the first of several similar ships already under construction, recently began her sea service after being launched and fitted out in the shipyard of the Ansaldo San Giorgio Company at Muggiano, Italy.

Classified as 100 A.I.I.L. in the Registro Nazionale Italiano, and in Class B.S. of the British Corporation, she is of the single-deck type, with special framing, which leaves the cargo holds entirely unobstructed by pillars or stanchions, thus greatly facilitating loading and unloading operations. Her principal dimensions are as follows:

Length overall	393 feet 11 inches
Length between perpendiculars	378 feet
Beam, extreme	51 feet 9 inches
Beam, molded	51 feet 6 inches
Load draft	24 feet 6 inches
Deadweight tonnage	8,100
Gross tonnage	5,580
Brake horsepower	2,200
Speed (full load)	11 knots

The ship is rigged with two masts, which serve also as derrick posts for the handling of cargo. Large compartments amidships and aft furnish up-to-date and comfortable living quarters. In the amidships house are cabins for the captain and officers, also the wireless station, galley, pantry and crew's quarters; in the poop are quarters for the engineers and firemen, and in the fore part of the same is the donkey boiler room. All these are steam heated and have electric light.

The propelling machinery is located in the stern. The cargo space, forward and amidships, is divided into six holds. By means of eight watertight transverse bulkheads, the vessel is divided into nine watertight compartments, giving complete assurance of buoyancy in case of accident to any part of the hull. The foremost and aftermost of these compartments (trimming tanks) can contain, respectively, 4,273 and 4,450 cubic feet of water ballast.

The vessel has a cellular double bottom throughout, divided into six compartments, the after three of which are used for fuel oil for the Diesel engines and donkey boilers, while in the others, 31,783 cubic feet of mineral oil can be carried. Every compartment of the double

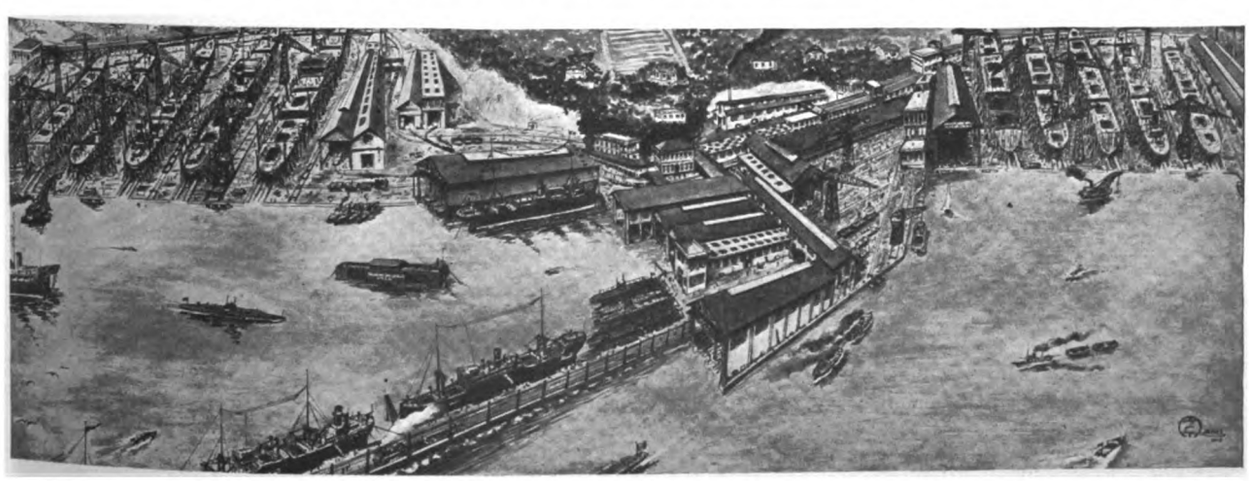

Fig. 2.—Shipyards of the Ansaldo San Giorgio Company, Muggiano (Spezia). From a Sketch

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bottom can be filled and emptied by means of the auxiliary pumps.

The propelling machinery consists of two single-acting two-cycle Diesel engines built at the Turin shops of the Ansaldo San Giorgio Company. The two engines together develop 2,200 brake horsepower at 100 revolutions per minute, and each has four cylinders, 20 13/16-inch bore by 35 7/16-inch stroke; they are of the reversible type, alike in details and symmetric in arrangement.

All auxiliaries, such as scavenging pumps, air compressors, oil pump, water-cooling pump, etc., are driven directly by the main engines, being placed on continuations of the crankshafts forward of the engines, thus avoiding any lateral encumbrance of the motors.

The exhaust gases pass into silencers, and a complete system of ventilators assures good ventilation of the engine room.

All operations of starting and reversing the engines can be made from the central platform, where a complete set of manometers and other controlling apparatus permit easy surveillance of the Diesel engines and of all the auxiliary machinery.

The several operations of steering the ship, handling the cargo, filling and emptying the double bottoms, etc., are performed by means of a complete set of modern auxiliary engines, consisting of windlass, eleven winches for hold service, steering gear, electric generator of 5.5 kilowatts and 110 volts for illumination, air compressor for charging the tanks that supply compressed air for starting the Diesel engines, auxiliary condenser for the exhaust steam of the auxiliaries, water distiller with a capacity of 10 tons daily, pumps for ballast, fire and sanitary service, liquid fuel, etc.

All auxiliaries are steam-driven, the power being furnished by two oil-fired vertical type Blake boilers, installed in the forward part of the aft house. Each boiler can supply sufficient steam to drive two-thirds of the auxiliaries at one time.

This is the first of this type of vessel to go into commission, and her performance is arousing the deepest interest among marine engineers and shipowners. The *Ansaldo San Giorgio I* completed her maiden voyage on June 1, when she reached Genoa after taking a full cargo of ore from Cartagena, Spain, to Glasgow, returning laden with coal for Italy. In spite of bad weather throughout the voyage, she averaged eleven miles an hour, with a daily consumption of ten tons of fuel oil.

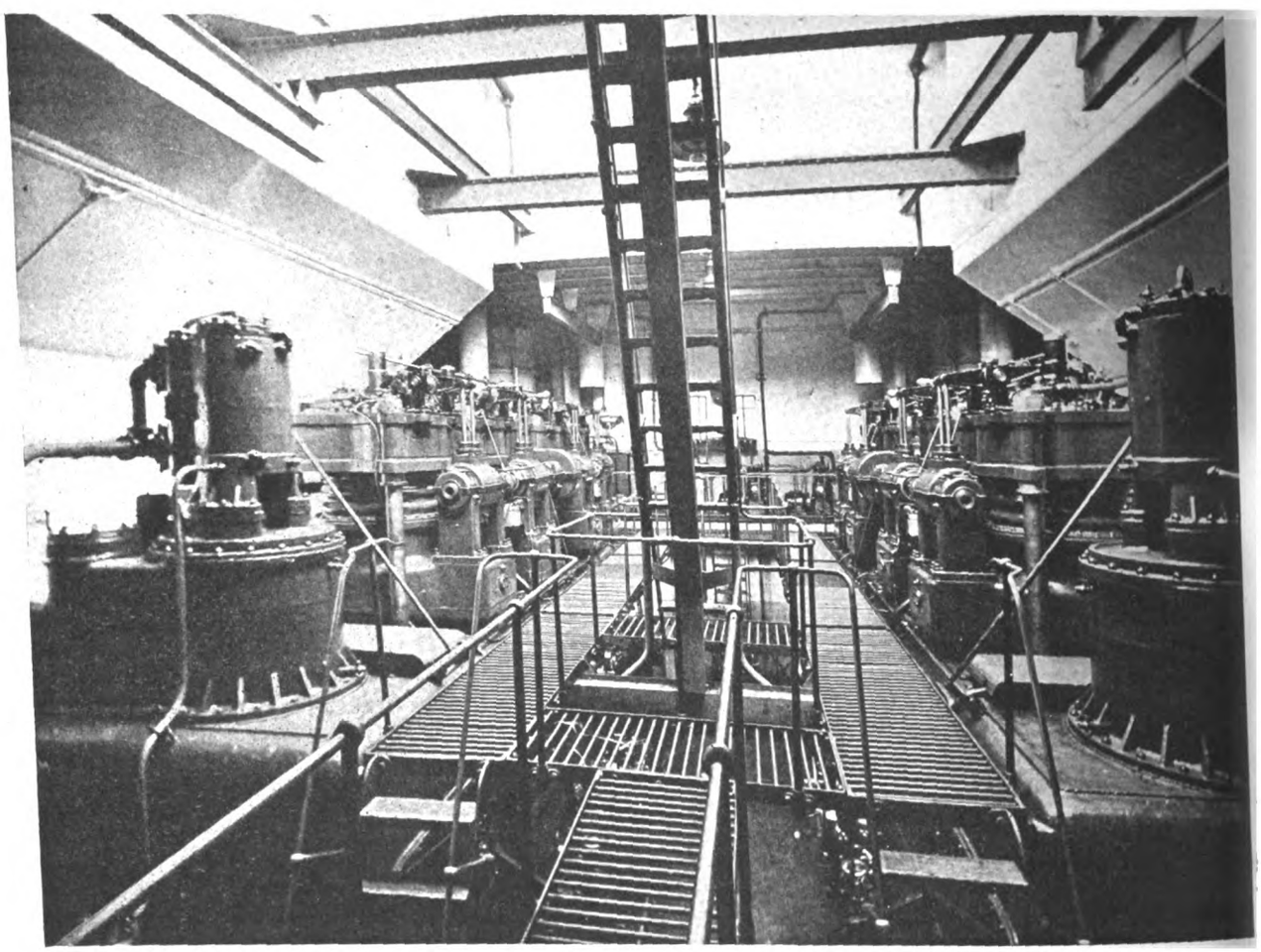

Fig. 3.—Engine Room of the *Ansaldo San Giorgio I*

The Ansaldo San Giorgio Company, her builder, was until recently the Fiat San Giorgio, under which name it won a world-wide reputation. During the war, Giorgio Ansaldo & Company, the great engineering and shipbuilding concern of Genoa, bought a controlling interest in the company and changed the name to conform with its own. The plant of the company consists of the shipyards at Muggiano (Spezia) and the engine works at Turin.

After long experience in the building of steamships (of which more than forty were built, some of these

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Fig. 4.—The Assembly Shops at the Ansaldo San Giorgio Company's Engine Works, Turin

Fig. 5.—Interior of the Ansaldo San Giorgio Company's Engine Works at Turin

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being about 20,000 tons displacement), the company decided to devote its facilities especially to the building of motorships. On the basis of tests and practical results, the engineers of the Ansaldo San Giorgio Company decided to devote themselves exclusively to the construction of the two-cycle engine, which presents the following advantages over the four-cycle:

1. Development of greater power, giving as a consequence considerable saving in weight, which can be calculated as approximately 35 percent.

2. Greater facility for reversing, and therefore much less complicated mechanism.

3. Elimination of exhaust valves, which in the four-cycle engines are a source of trouble, being very sensitive to the quality of the fuel and easily damaged by the asphalt and sulphur contained in certain qualities of heavy oils; the two-cycle engine, without exhaust valves, can consequently use certain kinds of fuel which are not suitable for four-cycle engines.

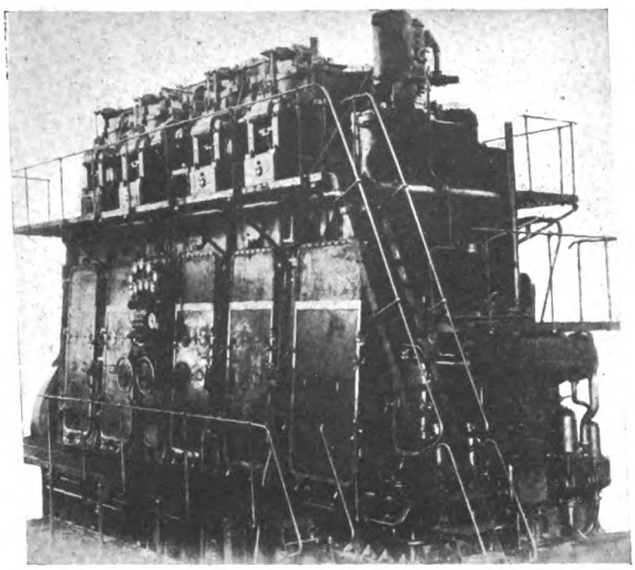

Fig. 6.—1,500-Horsepower Diesel Engine Built by the Ansaldo San Giorgio Company

4. Much more regular moment of torsion, an advantage that resolves itself practically into a smaller intensity of vibrations of the ship and a reduction in the dimensions and weight of the line shafting and of its accessories.

It is likewise to be noted that the smaller dimensions of the flywheel make it possible to place the engines nearer the stern of the ship, so that there is not only a saving in the length of the shafting but also an increase in the space available for cargo.

The real merits of the two-cycle Diesel engines, united with the perfection in construction attained by the engine works at Turin, permitted the Ansaldo San Giorgio Company to build the series of submersible torpedo-boats that are so well known and appreciated in Italy and abroad for the special construction of the hull (Laurenti's patents) and for the perfection of their propelling machinery, which consists of two-cycle Diesel motors of 350 to 1,300 brake horsepower. More than 92 of these submarines have been built in the shipyard at Muggiano for the navies of Italy, Brazil, Denmark, England, Portugal, Spain, Sweden, the United States and Russia. At the same time the engine works at Turin constructed about 250 engines with a total of more than 200,000 brake horsepower. Later on the motorship *Ceara*, 4,100 tons displacement, with two engines of 2,300 horsepower, was built, and then the latest series of motorships of 12,000 tons displacement with two engines of 1,600 horsepower.

Encouraged by the practical results already obtained, the Ansaldo San Giorgio Company looked for a standard type of motorship that should possess the highest qualities of economy, efficiency and reliability. After long and careful study its choice fell upon the type of motorship of 8,100 tons deadweight capacity, of which the *Ansaldo San Giorgio I*, described above, is the first example.

The economic superiority of the modern motorship over the steamship and its advantages may be summarized as follows:

The weight of the fuel used by the internal combustion engines is much less than the weight of the coal necessary for the steam engine, so the motorship can carry cargo where the steamship must carry fuel, thus obtaining a considerable increase in profit.

The power developed by the engines of the motorship and steamship being equal, the cost of the liquid fuel used in the former is notably inferior to the cost of the coal burned by the latter; thus the motorship realizes another large saving in money.

The operations of loading the liquid fuel are accomplished with more cleanliness than the corresponding operations for the coal.

The management of the Diesel engine requires a reduced engine room staff and no firemen.

A single, simple example will show these advantages as follows:

For the two-cycle marine Diesel engines built by the Ansaldo San Giorgio Company a fuel consumption of not more than 0.43 pound per brake horsepower hour was obtained. On a steamship the coal consumption, including auxiliary machinery, is usually in the neighborhood of two pounds per indicated horsepower, or 2.35 pounds per brake horsepower.

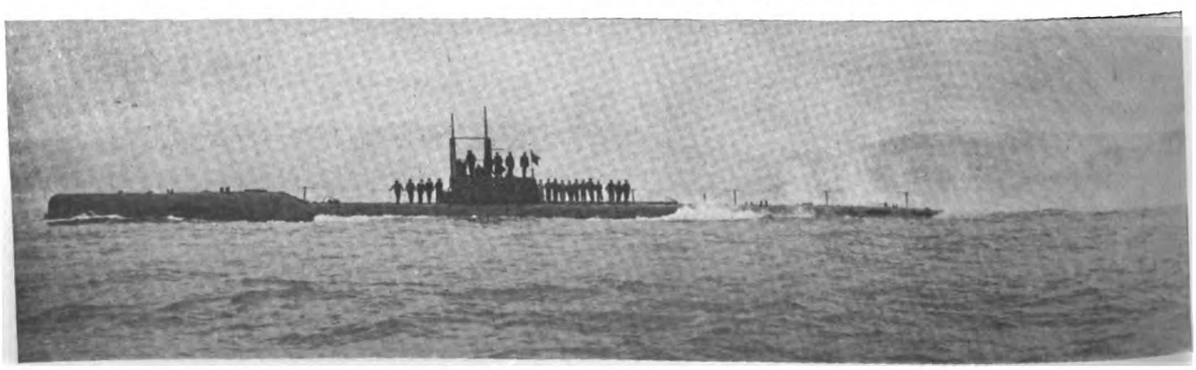

Fig. 7.—Italian Submarine Built and Engined by the Ansaldo San Giorgio Company

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Therefore the motorship *Ansaldo San Giorgio I,* with her engines of 2,000 horsepower, burns 0.384 ton of heavy oil per hour. Starting with 250 tons of fuel, she can run 650 hours. With her speed of 11 knots she can run a distance of 7,150 miles, carrying 8,000 tons of cargo.

A steamship of the same capacity, with steam engines of the same power and speed, will burn 2.1 tons of coal per hour. For running the same distance of 7,150 miles, she must carry in her bunkers 1,360 tons of coal, carrying, therefore, only 6,890 tons of cargo.

What will be the financial result of the voyage for the two ships?

Neglecting the savings of the motorship in reduced engine room staff, ease of loading the fuel, etc., let us consider only the greater profit obtained from the greater cargo capacity and the saving in money in reduced consumption of fuel. Referring to actual prices* we can calculate for a voyage like the one assumed, a freight of 150 shillings a ton of cargo, cost of oil 140 shillings a ton, cost of coal 80 shillings a ton. Thus we shall have:

MOTORSHIP

	Shillings
Freight for 8,000 tons of cargo at 150 shillings	1,200,000
Cost of 250 tons of oil at 140 shillings	35,000
Profit	1,165,000

STEAMSHIP

	Shillings
Freight for 6,890 tons of cargo at 150 shillings	1,033,500
Cost of 1,360 tons of coal at 80 shillings	108,800
Profit	924,700

Thus the motorship will realize a profit greater by 240,300 shillings than the steamship in a single voyage. probably eight such voyages can be made in one year, so that for a motorship like the *Ansaldo San Giorgio I,* compared with a similar steamship, the greater profits and savings may amount to a total of £96,120 sterling, or about $467,000 per annum.

The difference in initial cost of the two vessels is only about $487,000 (£100,000).

*It is to be observed that, although the figures assumed for the prices of coal and crude oil may be different in different parts of the world, their ratio is nearly constant; also the freight market always varies with tonnage requirements, consequently the profit that a shipowner can expect from his ship varies also. For these reasons, whatever the steady peace prices may become, the profit calculation will not lose its value.

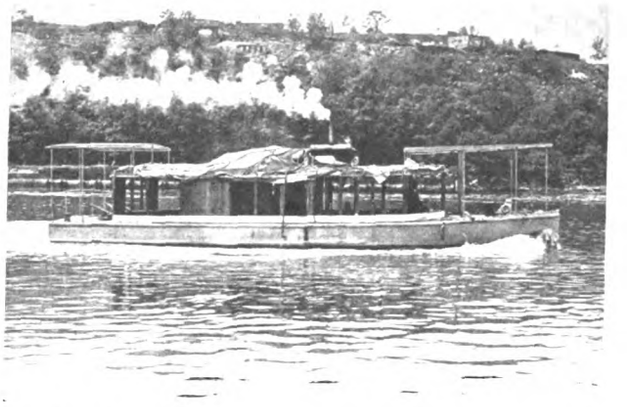
Launch Designed for Explorer

A RATHER unique type of launch has been built for Dr. Hamilton K. Rice, of Boston, by the Consolidated Shipbuilding Corporation, Morris Heights, N. Y. The boat will be used on his fifth trip of exploration along the Rio Negro river in Brazil. This launch is the development of a peculiar tunnel stern construction successfully used on previous boats built for Dr. Rice by the same company. It is well adapted to the navigating of shallow waters, and the protection afforded the rudder and the propeller by the tunnel enables the boat to negotiate small rapids and other obstructions without difficulty.

The boat is 45 feet long with a 14-foot beam and a draft of 2 feet and is built to withstand rough usage. Her power plant consists of a 30-horsepower, 6-inch by 6½-inch air-starting Mietz kerosene (paraffin) engine, equipped with a Delco ¾-kilowatt generating set for supplying current to the electrical equipment. Fuel tanks with a capacity of 1,200 gallons allow a cruising radius of 1,800 miles at a speed of 8 miles per hour.

A chain locker is arranged in the forepeak, entered by a small hatch. Next aft is the tank compartment, followed by the forward cabin. The steering wheel, compass and binnacle are forward in this cabin, while side transom seats are fitted with lockers. Entrance steps are placed on the port and starboard sides. On the port side is the toilet room; on the starboard side the galley, equipped with a kerosene (paraffin) stove, sink, dish rack, drainboard, lockers, etc.

The after cabin includes transom berths on either side and lockers. A dresser is installed in the after end with spring cushion seats on either side. This cabin is fitted



Shallow Draft Launch Built for Exploration of Brazilian River

with two large lockers, gun racks, etc. The bath room is located on the port side forward. Under the after deck a second fuel tank is arranged. Following this is a locker space for the stowage of miscellaneous gear, stores, etc. This compartment is made accessible by two 18-inch hatches. Towing bitts are located on the port and starboard sides of the deck.

Awnings, supported by galvanized iron stanchions and spruce spreaders, cover the forward and after decks, and hinged copper screens, arranged to swing inboard, enclose all openings.

The launch made a successful trial run on the Hudson river before her acceptance by Dr. Rice. Later she was dismantled for shipment to South America.

War-Blinded Soldiers Find Work in Shipyards

While endeavoring to find sufficient help in order to fill his war contracts with the United States Government, it occurred to F. J. Luebbert, head of a tent manufacturing concern, that if the blind were capable of becoming adept at basket weaving, the same principles would apply to making complicated knots and splices. His offer of work to students of several institutions for the blinded in war was accepted. The result proved a complete success. By patient work, with the aid of a heavy rope over which Mr. Luebbert could guide the hands of his pupils, the workers were able at the end of a week to make the Matthew Walker knot with ease.

Mr. Luebbert has suggested that these people could be used by the United States Shipping Board in making rigging for the new merchant marine fleet which we are constructing, since there is much work in rigging lofts which they could do as expertly as a sound worker.

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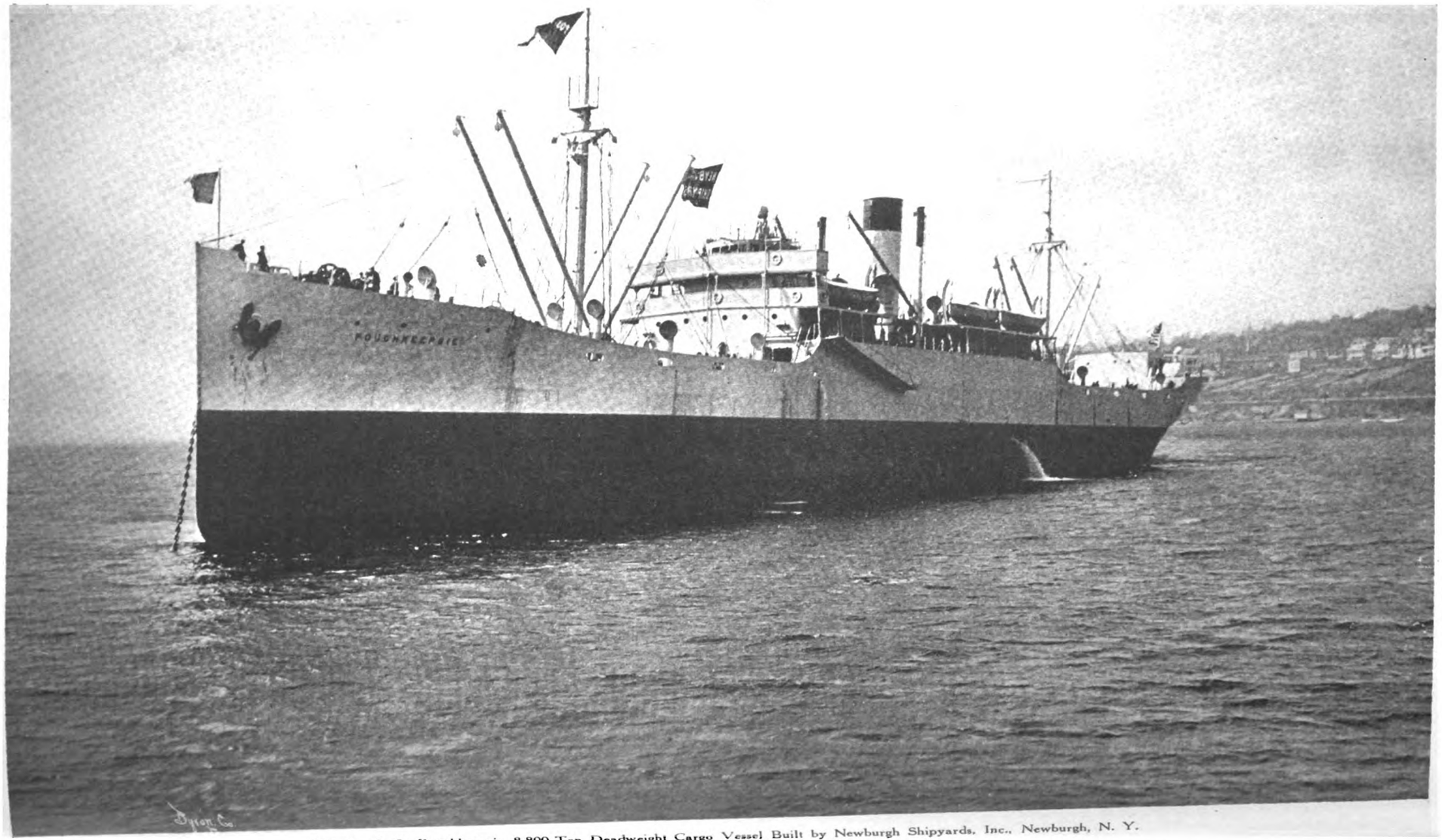

Fig. 1.—S. S. *Poughkeepsie*, 8,800-Ton Deadweight Cargo Vessel Built by Newburgh Shipyards, Inc., Newburgh, N. Y.

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S. S. Poughkeepsie, Standard 8,800-Ton Deadweight Cargo Vessel Built by Newburgh Shipyards, Inc.

Two-Deck, Single-Screw Steamship Fitted with Watertube Boilers and Geared Tnrbines—Arranged for Both Coal and Oil Fuel

THE standard type of cargo vessel now being built by the Newburgh Shipyards, Inc., Newburgh, N. Y., for the United States Shipping Board Emergency Fleet Corporation is a single-screw steamship of 8,822 tons deadweight. The vessel, which is of the two-deck, poop, bridge and forecastle type, is built on the transverse system of framing with wide-spaced hold stanchions on the centerline of the ship supporting deep transverse belt beams, to which are connected two deep longitudinal deck girders. This construction leaves the holds remarkably clear for the storage of cargo.

The principal dimensions of the vessel are as follows:

Length overall	417 feet 10 inches
Length between perpendiculars	401 feet
Breadth molded	54 feet
Depth molded to upper deck	32 feet 10 inches
Distance between upper deck and second deck	9 feet
Distance between upper deck and bridge deck	8 feet 3 inches
Depth to double bottom	44 inches
Rise of floor	6 inches
Draft, Lloyd's summer freeboard	25 feet 6 inches
Deadweight on above draft	8,822 tons
Shaft horsepower (approximate)	3,000
Sea speed, loaded	10½ knots

The vessel has one smokestack and two steel masts. The foremast carries four wooden 5-ton booms and one steel 30-ton boom. The main mast carries four wooden 5-ton booms. Two 5-ton booms are mounted on king posts for handling cargo through the amidship hatch. These booms serve five cargo hatches, four of which are 29 feet 3 inches long by 20 feet wide, and one 18 feet long by 20 feet wide. The cargo is handled by eight 9-inch by 9-inch winches of the double-cylinder single-drum type, with single-winch heads, and two winches of similar type with double-winch heads. The winches are arranged four at each mast on the upper deck and two on the bridge deck.

Hull Construction

A double bottom of the cellular type, 44 inches in depth at the centerline, extends throughout the vessel. In addition to a watertight center keelson, the double bottom is further divided into six transverse compartments and has a capacity of 1,077 tons of fuel oil in five transverse tanks and 141 tons of fresh water in one transverse tank.

Seven transverse watertight bulkheads divide the vessel into five cargo holds and machinery spaces. Hold No. 1 is 65 feet 3 inches long; hold No. 2, 60 feet 9 inches; hold No. 3, 45 feet with machinery space of 51 feet 9 inches; hold No. 4 is 63 feet, and hold No. 5 is 72 feet. The bridge enclosure, which is 123 feet long, is arranged for carrying either coal or cargo.

Cargo battens of 6-inch by 2-inch pine are fitted in all lower cargo holds, 'tween deck cargo holds and in the bridge enclosure.

Fuel Bunkers

In addition to the fuel oil carried in the double bottom, the fore peak tank is also arranged for carrying 120 tons of fuel oil, which with the settling tanks in the engine room gives a total fuel oil capacity of 1,260 tons.

When the vessel is arranged for burning coal, No. 3 hold is utilized as a coal bunker, as are also the 'tween deck spaces alongside of the machinery, making the total available coal capacity 1,846 tons.

Crew Accommodations

Accommodations for officers are arranged in two steel deck houses on the bridge deck. The forward house contains accommodations for the captain, supercargo and hospital, navigating officers, radio room and saloon, with the usual pilot house and chart room superposed thereon. The after house contains accommodations for the engineering officers, water tenders and oilers. The galley is arranged at the after end of the house.

Quarters for the firemen, seamen, cadets and mess boys, with the necessary toilet accommodations, are arranged within the poop enclosure. On the poop deck is a steel deck house containing separate dining rooms for the firemen, seamen and cadets, and cabins for carpenter, boatswain, storekeeper, deck engineer and cook's mate. In the forecastle is arranged boatswain's stores, cook's stores and the carpenter's work shop. At the after end of the bridge enclosure are located two tanks containing 26 tons of drinking water, an ice machine room with a one-ton Frick ammonia machine, insulated cold room and meat room for the ship's complement.

Propelling Machinery

The main propelling machinery, located midships, consists of a cross-compound high- and low-pressure Westinghouse turbine running at 3,600 revolutions per minute and driving the line shaft at 90 revolutions per minute through a set of floating frame, double-reduction helical gears. When the turbine is supplied with steam at 185 pounds per square inch gage pressure, with 75 degrees superheat and under a vacuum of 28 inches of mercury (referred to a 30-inch barometer), it will develop 3,000 shaft horsepower at 90 revolutions per minute, consuming 11.25 pounds of steam per shaft horsepower hour.

The high-pressure ahead turbine consists of a combination of two rows of Curtis blading and fourteen rows of Parsons blading; the low-pressure ahead turbine has ten rows of Parsons blading. Within the casings of both high- and low-pressure ahead turbines are located two rows of Curtis astern blades, which operate at 60 percent of the power of the ahead blades when the same amount of steam is used under throttle and condenser pressures mentioned above.

The thrust bearing of the Kingsbury type is located at the forward end of the gear case. The propeller is of the cast iron built-up type, 17 feet in diameter with a 14-foot pitch.

The engine room auxiliaries include a main condenser with 4,000 square feet of cooling surface, supplied with cooling water by a 4,000-gallon circulating pump driven by a 52-brake-horsepower steam turbine through reduc-

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tion gears from 6,900 revolutions per minute to 575 revolutions per minute. Two turbine-driven condensate pumps deliver the condensate from the condenser to the feed and filter tank. A LeBlanc ejector removes the air from the condenser. The following service pumps are included in the auxiliary apparatus:

PUMPS—TYPE AND SIZE

Two main and auxiliary vertical simplex feed pumps, 12 inches by 8 inches by 24 inches.

One vertical duplex evaporator feed pump, 4½ inches by 4 inches by 4 inches.

Two horizontal duplex fuel oil service pumps, 5¼ inches by 3½ inches by 5 inches.

One vertical duplex engine room bilge pump, 6 inches by 5¾ inches by 6 inches.

One horizontal simplex air and circulating pump for auxiliary condenser, 10 inches by 12 inches by 12 inches by 12 inches.

Two horizontal duplex lubricating oil pumps, 7½ inches by 7½ inches by 10 inches.

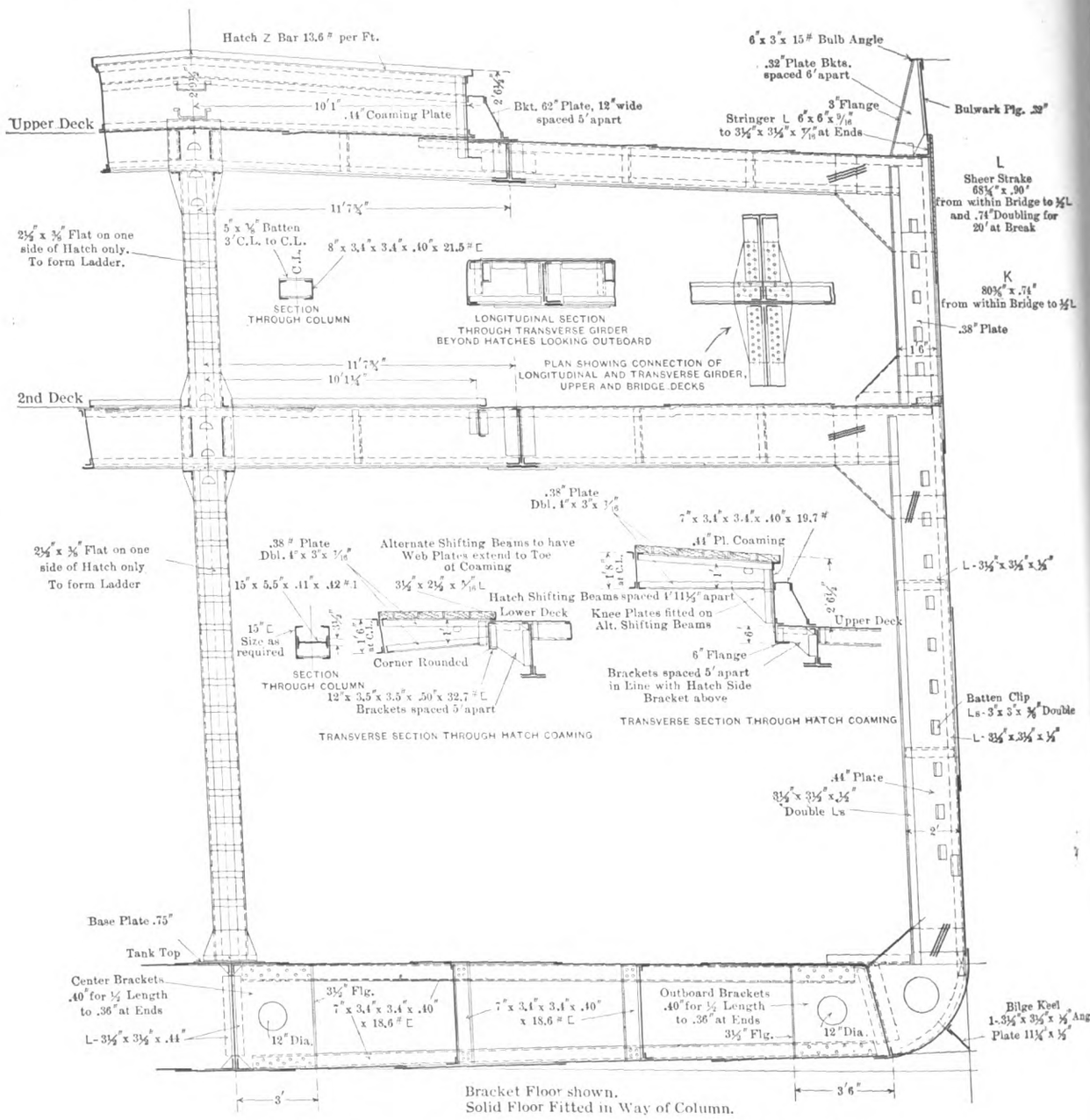
Hatch Z Bar 13.6 # per Ft.
6" x 3" x 15# Bulb Angle
.32" Plate Bkts. spaced 6' apart
Bulwark Plg. .32"
3" Flange
Stringer L 6" x 6" x 9/16" to 3½" x 3½" x 7/16" at Ends
Bkt. 62" Plate, 12" wide spaced 5' apart
.44" Coaming Plate
10'1"
Upper Deck
L
Sheer Strake 68¼" x .90" from within Bridge to ½L and .74" Doubling for 20' at Break
K
80¾" x .74" from within Bridge to ½L
.38" Plate
11'7¾"
2½" x ⅜" Flat on one side of Hatch only. To form Ladder.
5" x ¼" Batten 3' C.L. to C.L.
8" x 3.4" x 3.4" x .40" x 21.5 # C
C.L.
SECTION THROUGH COLUMN
LONGITUDINAL SECTION THROUGH TRANSVERSE GIRDER BEYOND HATCHES LOOKING OUTBOARD
PLAN SHOWING CONNECTION OF LONGITUDINAL AND TRANSVERSE GIRDER, UPPER AND BRIDGE DECKS
10'11¾"
2nd Deck
.38" Plate Dbl. 4" x 3" x 7/16"
7" x 3.4" x 3.4" x .40" x 19.7 #
.44" Pl. Coaming
2½" x ⅜" Flat on one side of Hatch only To form Ladder
.38 # Plate Dbl. 4" x 3" x 7/16"
Alternate Shifting Beams to have Web Plates extend to Toe of Coaming
15" x 5.5" x .41" x .42 # I
3½" x 2½" x 7/16" L
Hatch Shifting Beams spaced 11½" apart
Lower Deck
Knee Plates fitted on Alt. Shifting Beams
Upper Deck
15" C Size as required
Corner Rounded
6" Flange
Brackets spaced 5' apart in Line with Hatch Side Bracket above
SECTION THROUGH COLUMN
12" x 3.5" x 3.5" x .50" x 32.7 # C
Brackets spaced 5' apart
TRANSVERSE SECTION THROUGH HATCH COAMING
TRANSVERSE SECTION THROUGH HATCH COAMING
L - 3½" x 3½" x ½"
Batten Clip Ls - 3" x 3" x ⅜" Double
L - 3½" x 3½" x ½"
.44" Plate
3½" x 3½" x ½" Double Ls
Base Plate .75"
Tank Top
Center Brackets .40" for ½ Length to .36" at Ends
L - 3½" x 3½" x .44"
12" Dia.
3½" Flg.
7" x 3.4" x 3.4" x .40" x 18.6 # C
7" x 3.4" x 3.4" x .40" x 18.6 # C
Outboard Brackets .40" for ½ Length to .36" at Ends
3½" Flg.
12" Dia.
Bilge Keel 1 - 3½" x 3½" x ½" Angle Plate 11¼" x ½"
3'
3'6"
Bracket Floor shown. Solid Floor Fitted in Way of Column.

Fig. 2.—Section at Forward and After Ends of Bridge, S. S. *Poughkeepsie*

One vertical duplex ballast pump, 10 inches by 12 inches by 12 inches.

One vertical duplex fire and bilge pump, 10 inches by 8½ inches by 12 inches.

One horizontal duplex fuel oil transfer pump, 7½ inches by 7½ inches by 10 inches.

One horizontal duplex sanitary pump, 6 inches by 5¾ inches by 6 inches.

One horizontal duplex fresh water pump, 4½ inches by 3¾ inches by 4 inches.

One horizontal duplex lubricating oil cooler circulating pump, 7½ inches by 7½ inches by 10 inches.

One motor-driven centrifugal drinking water circulating pump with a capacity of 10 gallons per minute.

The engine room is also equipped with one evaporator, evaporating 25 tons per 24 hours, a feed water heater capable of heating 40,000 pounds of water from 80 degrees to 212 degrees Fahrenheit at a back pressure of 5 pounds gage, a feed and filter tank, an inspection tank, and an

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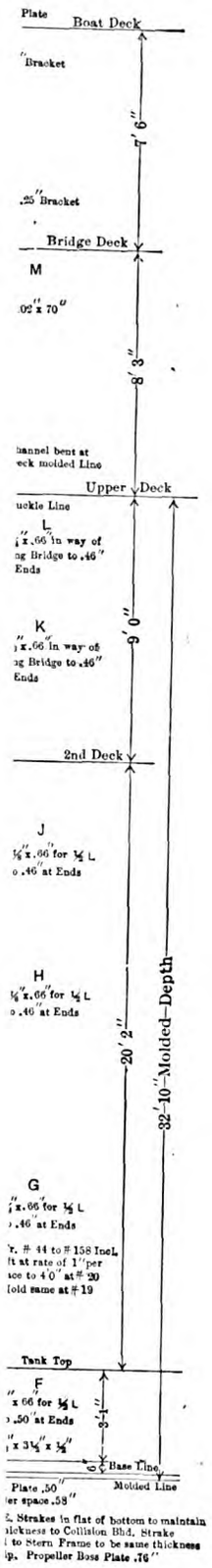

apparatus and motors,
nes and reduction gear
a 400-gallon filter and
one of two oil coolers,
e feet each and an oil

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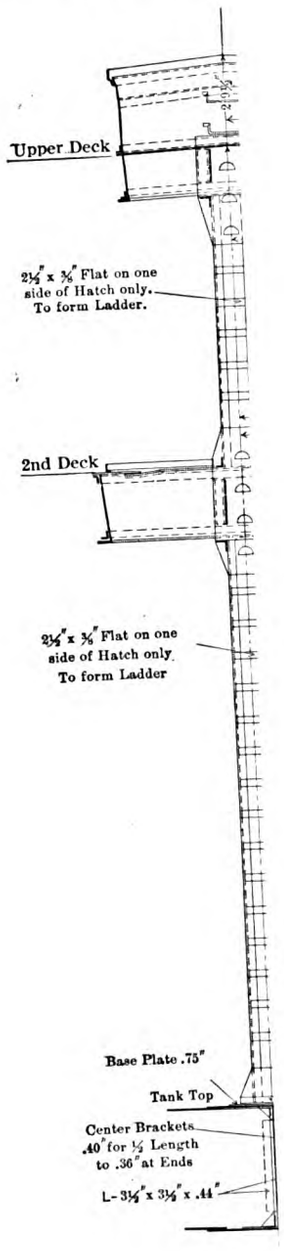
tion gears from 6,900 r
tions per minute. Tw
deliver the condensate
filter tank. A LeBlan
condenser. The follo
the auxiliary apparatu

PUMI

Two main and auxil
inches by 8 inches by 2


Upper Deck
2½" x ⅜" Flat on one side of Hatch only. To form Ladder.
2nd Deck
2½" x ⅜" Flat on one side of Hatch only. To form Ladder
Base Plate .75"
Tank Top
Center Brackets .40" for ½ Length to .36" at Ends
L-3½" x 3½" x .44"

One vertical duplex
12 inches.
One vertical duplex
inches by 12 inches.
One horizontal dupl
7½ inches by 10 inch
One horizontal du
inches by 6 inches.
One horizontal dupl
inches by 4 inches.

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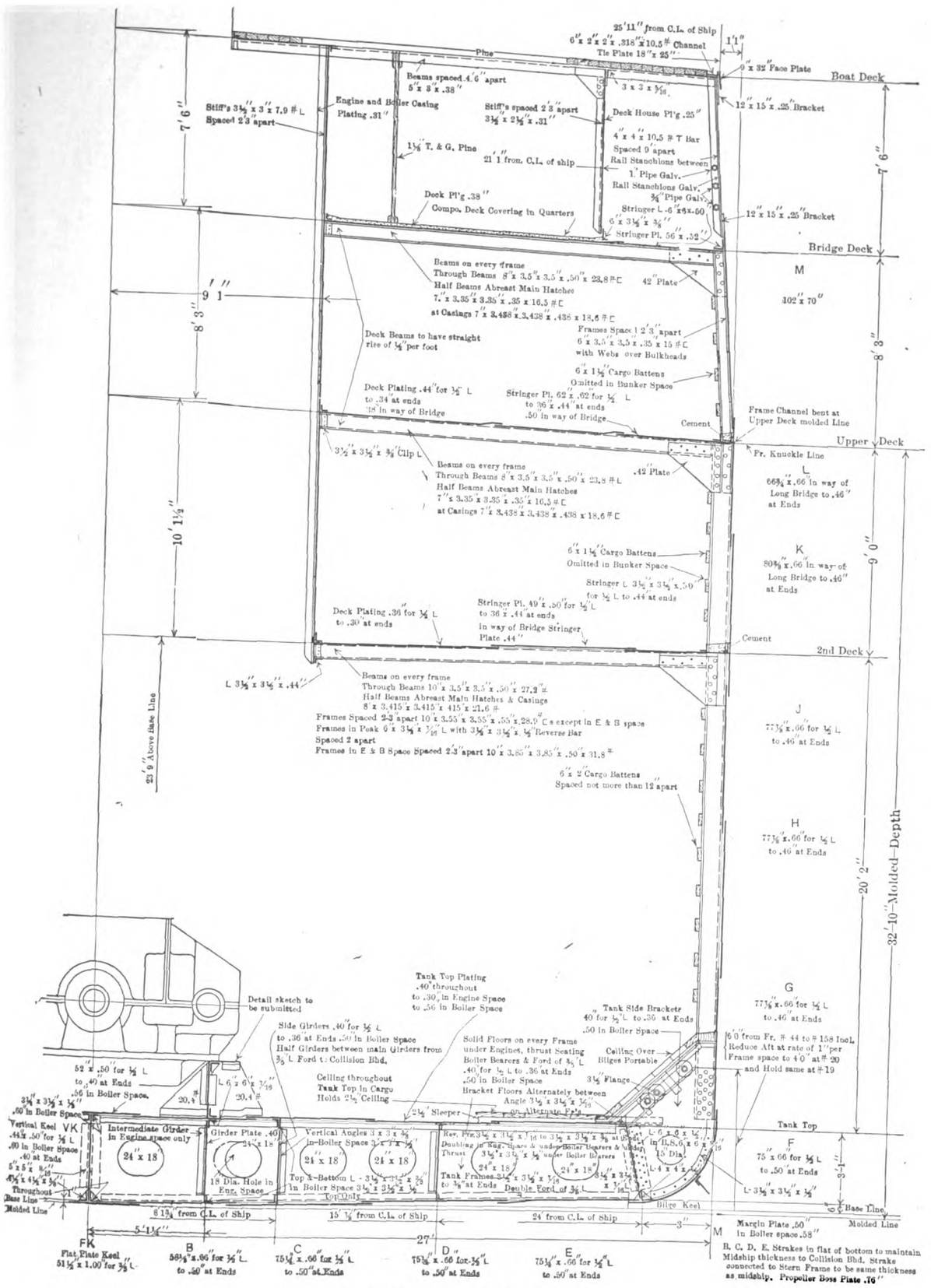
Boat Deck
Bridge Deck
Upper Deck
2nd Deck
Tank Top
Base Line
Molded Line
Molded Depth
32'10"
20'2"
9'0"
8'3"
7'6"
10'1½"
23'9" Above Base Line
Pine
Engine and Boiler Casing Plating .31"
Deck House Pl'g .25"
Deck Pl'g .38"
Compo. Deck Covering in Quarters
Deck Plating .44" for ½" L to .34" at ends .38" in way of Bridge
Deck Plating .36" for ½ L to .30" at ends
Deck Beams to have straight rise of ¼" per foot
Cement
Frame Channel bent at Upper Deck molded Line
Fr. Knuckle Line
Detail sketch to be submitted
Tank Top Plating .40" throughout to .30" in Engine Space to .56 in Boiler Space
Tank Side Brackets .40 for ½"L to .36" at Ends .50 in Boiler Space
Side Girders .40" for ½ L to .36" at Ends .50 in Boiler Space
Half Girders between main Girders from ⅜" L Ford to Collision Bhd.
Solid Floors on every Frame under Engines, thrust Seating Boiler Bearers & Ford of ⅜" L .40" for ½ L to .36" at Ends .50" in Boiler Space
Bracket Floors Alternately between
Ceiling Over Bilges Portable
Ceiling throughout
Tank Top in Cargo Holds 2½" Ceiling
Intermediate Girder in Engine space only
Girder Plate .40"
Vertical Keel VK .44" .50" for ½ L .60 in Boiler Space .40" at Ends
Flat Plate Keel 51½" x 1.00" for ⅜" L
Margin Plate .50" in Boiler space .58"
B, C, D, E, Strakes in flat of bottom to maintain Midship thickness to Collision Bhd. Strake connected to Stern Frame to be same thickness as midship. Propeller Boss Plate .76"
Beams on every frame Through Beams 8"x 3.5"x 3.5"x .50"x 23.8#C Half Beams Abreast Main Hatches 7"x 3.35"x 3.35"x .35 x 16.5 #C at Casings 7"x 3.438"x 3.438"x .438 x 18.6 #C
Frames Space 2'3" apart 6"x 3.5"x 3.5"x .35 x 15 #C with Webs over Bulkheads
6"x 1½" Cargo Battens Omitted in Bunker Space
Stringer Pl. 62"x .62" for ½" L to 36"x .44" at ends .50" in way of Bridge
Stringer Pl. 56"x .52"
Stringer L 6"x6"x.50
Stringer Pl. 49"x .50" for ½" L to 36"x .44" at ends in way of Bridge Stringer Plate .44"
Beams on every frame Through Beams 10"x 3.5"x 3.5"x .50"x 27.2# Half Beams Abreast Main Hatches & Casings 8"x 3.415"x 3.415"x 415"x 21.6 #
Frames Spaced 2'3" apart 10"x 3.55"x 3.55"x .55"x 28.9# C s except in E & B space
Frames in Peak 6"x 3½"x ⅜" L with 3⅛"x ½" Reverse Bar Spaced 2' apart
Frames in E & B Space Spaced 2'3" apart 10"x 3.85"x 3.85"x .50"x 31.8#
6"x 2" Cargo Battens Spaced not more than 12" apart
Cement
Frames Space 1'2'3" apart
Stiff's 3½"x 3"x 7.9 #L Spaced 2'3" apart
Stiff's spaced 2'3" apart 3½"x 2½"x .31"
Beams spaced 4'6" apart 5"x 3"x .38"
1½" T. & G. Pine
21'1" from C.L. of ship
25'11" from C.L. of Ship
6"x 2"x 2"x .318"x 10.5# Channel Tie Plate 18"x 25"
3"x 3"x ⅜"
9"x 32" Face Plate
12"x 15"x .25" Bracket
4"x 4"x 10.5 # T Bar Spaced 9" apart
Rail Stanchions between 1" Pipe Galv.
Rail Stanchions Galv. ¾" Pipe Galv.
6"x 3½"x ⅜"
42" Plate
102"x 70"
66¾"x.66" in way of Long Bridge to .46" at Ends
80⅜"x.66" in way of Long Bridge to .46" at Ends
77⅛"x.66" for ½ L to .46" at Ends
75"x 66 for ½ L to .50" at Ends
6'0" from Fr. # 44 to # 158 Incl. Reduce Aft at rate of 1" per Frame space to 40" at # 20 and Hold same at # 19
Vertical Angles 3"x 3"x ⅜" in Boiler Space 3"x 3"x ⅜"
Top & Bottom L - 3½"x 3½"x ⅜" in Boiler Space 3½"x 3½"x ½" Top Only
Tank Frames 3¼"x 3½"x ⅜" to ⅜" at Ends Double Ford of ⅜" L
Rev. Fr. 3½"x 3½"x ⅜" to 3½"x 3½"x ⅜" at ends Doubling in Eng. Space & under Boiler Bearers & under Thrust
18 Dia. Hole in Eng. Space
Bilge Keel
Flange
Sleeper
Alternate Pairs
Detail sketch to be submitted
Beams on every frame Through Beams 8"x 3.5"x 3.5"x .50"x 23.8 #L Half Beams Abreast Main Hatches 7"x 3.35"x 3.35"x .35"x 16.5 #C at Casings 7"x 3.438"x 3.438"x .438 x 18.6 #C
3½"x 3½"x ⅜" Clip L
.42" Plate
L 3½"x 3½"x .44"
Stringer Pl. 49"x .50" for ½" L to 36"x .44" at ends in way of Bridge Stringer Plate .44"
6"x 1½" Cargo Battens Omitted in Bunker Space
Stringer L 3½"x 3½"x .50" for ½ L to .44" at ends
Frames Space 2'3" apart 10"x 3.55"x 3.55"x .55"x 28.9# C s except in E & B space
Frames in Peak 6"x 3½"x ⅜" L with 3⅛"x ½" Reverse Bar Spaced 2' apart
Frames in E & B Space Spaced 2'3" apart 10"x 3.85"x 3.85"x .50"x 31.8#
6"x 2" Cargo Battens Spaced not more than 12" apart
Cement
Stiff's 3½"x 3"x 7.9 #L Spaced 2'3" apart
Engine and Boiler Casing Plating .31"
Beams spaced 4'6" apart 5"x 3"x .38"
1½" T. & G. Pine
21'1" from C.L. of ship
Deck Pl'g .38"
Compo. Deck Covering in Quarters
Deck Beams to have straight rise of ¼" per foot
Deck Plating .44" for ½" L to .34" at ends .38" in way of Bridge
Stringer Pl. 62"x .62" for ½" L to 36"x .44" at ends .50" in way of Bridge
Cement
Frame Channel bent at Upper Deck molded Line
Fr. Knuckle Line
Beams on every frame Through Beams 8"x 3.5"x 3.5"x .50"x 23.8#C Half Beams Abreast Main Hatches 7"x 3.35"x 3.35"x .35 x 16.5 #C at Casings 7"x 3.438"x 3.438"x .438 x 18.6 #C
42" Plate
Deck Beams to have straight rise of ¼" per foot
Frames Space 2'3" apart 6"x 3.5"x 3.5"x .35 x 15 #C with Webs over Bulkheads
6"x 1½" Cargo Battens Omitted in Bunker Space
Stringer Pl. 62"x .62" for ½" L to 36"x .44" at ends .50" in way of Bridge
Deck Plating .44" for ½" L to .34" at ends .38" in way of Bridge
Cement
Frame Channel bent at Upper Deck molded Line
Fr. Knuckle Line
Beams on every frame Through Beams 8"x 3.5"x 3.5"x .50"x 23.8#L Half Beams Abreast Main Hatches 7"x 3.35"x 3.35"x .35"x 16.5 #C at Casings 7"x 3.438"x 3.438"x .438 x 18.6 #C
3½"x 3½"x ⅜" Clip L
.42" Plate
6"x 1½" Cargo Battens Omitted in Bunker Space
Stringer L 3½"x 3½"x .50" for ½ L to .44" at ends
Stringer Pl. 49"x .50" for ½" L to 36"x .44" at ends in way of Bridge Stringer Plate .44"
Deck Plating .36" for ½ L to .30" at ends
Cement
2nd Deck
Beams on every frame Through Beams 10"x 3.5"x 3.5"x .50"x 27.2# Half Beams Abreast Main Hatches & Casings 8"x 3.415"x 3.415"x 415"x 21.6 #
Frames Spaced 2'3" apart 10"x 3.55"x 3.55"x .55"x 28.9# C s except in E & B space
Frames in Peak 6"x 3½"x ⅜" L with 3⅛"x ½" Reverse Bar Spaced 2' apart
Frames in E & B Space Spaced 2'3" apart 10"x 3.85"x 3.85"x .50"x 31.8#
6"x 2" Cargo Battens Spaced not more than 12" apart
Tank Top Plating .40" throughout to .30" in Engine Space to .56 in Boiler Space
Tank Side Brackets .40 for ½"L to .36" at Ends .50 in Boiler Space
Side Girders .40" for ½ L to .36" at Ends .50 in Boiler Space
Half Girders between main Girders from ⅜" L Ford to Collision Bhd.
Solid Floors on every Frame under Engines, thrust Seating Boiler Bearers & Ford of ⅜" L .40" for ½ L to .36" at Ends .50" in Boiler Space
Bracket Floors Alternately between
Ceiling Over Bilges Portable
Ceiling throughout
Tank Top in Cargo Holds 2½" Ceiling
Intermediate Girder in Engine space only
Girder Plate .40"
Vertical Keel VK .44" .50" for ½ L .60 in Boiler Space .40" at Ends
Flat Plate Keel 51½"x 1.00" for ⅜" L
Margin Plate .50" in Boiler space .58"
B, C, D, E, Strakes in flat of bottom to maintain Midship thickness to Collision Bhd. Strake connected to Stern Frame to be same thickness as midship. Propeller Boss Plate .76"
Vertical Angles 3"x 3"x ⅜" in Boiler Space 3"x 3"x ⅜"
Top & Bottom L - 3½"x 3½"x ⅜" in Boiler Space 3½"x 3½"x ½" Top Only
Tank Frames 3¼"x 3½"x ⅜" to ⅜" at Ends Double Ford of ⅜" L
Rev. Fr. 3½"x 3½"x ⅜" to 3½"x 3½"x ⅜" at ends Doubling in Eng. Space & under Boiler Bearers & under Thrust
18 Dia. Hole in Eng. Space
Bilge Keel
Flange
Sleeper
Alternate Pairs
Tank Top
Base Line
Molded Line
Molded Depth
32'10"
20'2"
9'0"
8'3"
7'6"
10'1½"
23'9" Above Base Line
Pine
Boat Deck
Bridge Deck
Upper Deck
2nd Deck
M
102"x 70"
J
77⅛"x.66" for ½ L to .46" at Ends
K
80⅜"x.66" in way of Long Bridge to .46" at Ends
L
66¾"x.66" in way of Long Bridge to .46" at Ends
H
77⅛"x.66" for ½ L to .46" at Ends
G
77⅛"x.66" for ½ L to .46" at Ends
F
75"x 66 for ½ L to .50" at Ends
L 3½"x 3½"x ½"
L 6"x 4"x ½" in B.B. 6"x 6"x ⅝" 15 Dia.
L 4"x 4"x
FK
B
C
D
E
M
8'1¾" from C.L. of Ship
15'⅞" from C.L. of Ship
24' from C.L. of Ship
3"
5'11¼"
27"
Flat Plate Keel 51½"x 1.00" for ⅜" L
58⅛"x.66" for ⅜" L to .50" at Ends
75⅛"x .66" for ½" L to .50" at Ends
75⅛"x .66" for ½" L to .50" at Ends
75⅛"x .66" for ½" L to .50" at Ends
Margin Plate .50" in Boiler space .58"
B, C, D, E, Strakes in flat of bottom to maintain Midship thickness to Collision Bhd. Strake connected to Stern Frame to be same thickness as midship. Propeller Boss Plate .76"

Fig. 4.—Midship Section, S. S. *Poughkeepsie*

auxiliary condenser with 800 square feet of cooling surface.

The electric power plant consists of two 12½-kilowatt, 125-volt turbine driven direct-current generators running at 4,000 revolutions per minute and delivering current to all lamps, lights, telemotors, wireless apparatus and motors.

The lubricating oil for the turbines and reduction gear is pumped from a drain tank to a 400-gallon filter and gravity tank after passing through one of two oil coolers, with cooling surfaces of 300 square feet each and an oil

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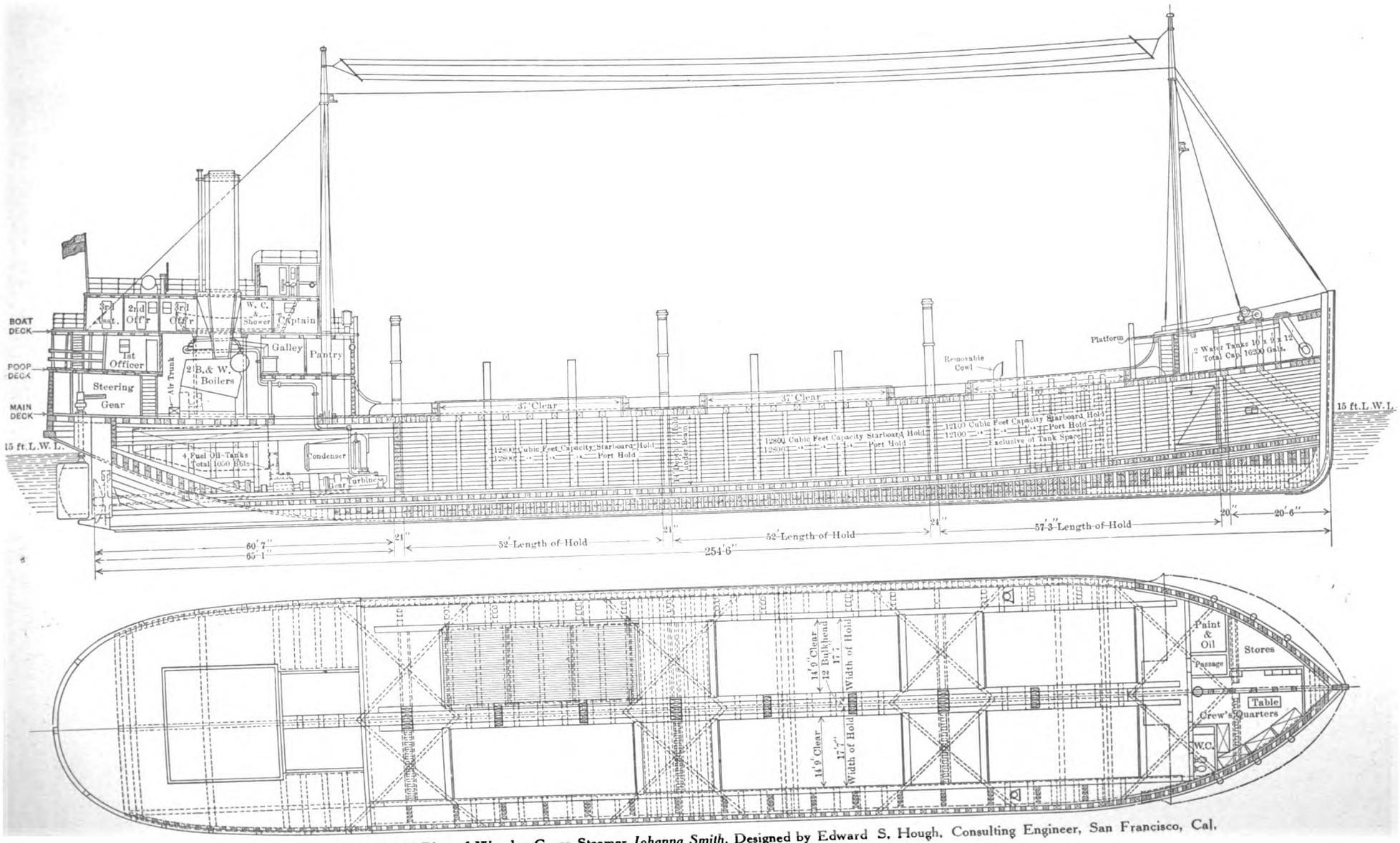

Fig. 1.—Inboard Profile and Hold Plan of Wooden Cargo Steamer *Johanna Smith*, Designed by Edward S. Hough, Consulting Engineer, San Francisco, Cal.

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strainer. From the filter and gravity tank the oil passes by gravity to the turbine, reduction gear and circulating pump and thence back to the drain tank.

BOILERS

Three single-drum Babcock & Wilcox watertube boilers with heating surfaces of 2,900 square feet each and carrying a pressure 200 pounds per square inch are installed. A superheater is arranged in the first pass of each boiler, giving the steam a superheat of 75 degrees. The boilers are equipped with a system of induced draft, which consists of two 86-inch steel plate fans in the uptakes, which are directly connected to two vertical direct-acting engines. The uptakes are so arranged and controlled by a system of dampers that natural draft may be substituted for induced draft.

The boilers are oil-fired, with provision made for using coal when economy so demands. Each boiler is fitted with five spray oil burners. The oil, which is stored in the inner bottom tanks, is pumped into two 8,000-gallon settling tanks situated on the port and starboard sides aft of the engine room. From this point two fuel oil service pumps deliver it to the burners through one of two oil heaters and the duplex strainer.

STEERING GEAR

The vessel is steered by a 9-inch by 9-inch double-cylinder screw gear having a right- and left-hand screw, controlled at the steering engine by a hand wheel. The steam valves of the engine under normal conditions are operated by an electric telemotor, with steering stations in the pilot house and on top of the pilot house. Two large wheels are located on the poop deck just aft of the house for steering the vessel by hand, in addition to which there is an emergency steering gear whereby the rudder may be operated from the after capstan.

CARGO CAPACITY

A complete tabulation of the capacity of holds and tanks is as follows:

	Grain, Cubic Feet	Bales, Cubic Feet
Hold No. 1	49,768	45,768
Hold No. 2	64,014	59,734
Hold No. 3	46,840	43,536
Hold No. 4	63,520	59,152
Hold No. 5	43,760	40,000
'Tween deck, hold No. 1	23,248	21,184
'Tween deck, hold No. 2	31,383	28,595
'Tween deck, hold No. 3	23,220	21,024
'Tween deck, hold No. 4	32,208	29,312
'Tween deck, hold No. 5	33,778	30,610
'Tween deck, side bunker	16,040	13,920
Bridge space	26,265	25,513
Bridge side bunker	15,296	13,064
Hatch No. 1	1,439	1,355
Hatch No. 2	1,439	1,355
Hatch No. 3	223	210
Hatch No. 4	1,439	1,355
Hatch No. 5	1,439	1,355
Bridge hatch B. H.	886	834
Total available cargo capacity	476,205	437,876
Cargo capacity, excluding hold No. 3, 'tween deck, side bunker and bridge side bunker	398,029	367,356

CAPACITY OF FUEL SPACES

	Cubic Feet	Tons Oil at 38 Cubic Feet	Tons Coal at 43 Cubic Feet
Hold No. 3	46,840	.....	1,089.3
'Tween deck side bunker	16,040	.....	373.0
Bridge side bunker	15,296	.....	355.7
Coal chutes	1,200	.....	27.9
Double-bottom tank No. 1	6,728	177.1	.....
Double-bottom tank No. 2	9,680	254.7	.....
Double-bottom tank No. 3	7,170	188.7	.....
Double-bottom tank No. 4	7,859	206.8	.....
Double-bottom tank No. 5	9,513	250.3	.....
Settling tanks	2,371	62.4	.....
Fore-peak tank	4,207	120.2	.....
Total		1,260.2	1,845.9

SPACES AVAILABLE FOR WATER BALLAST

	Cubic Feet	Tons Salt Water
Fore-peak tank	4,207	120.2
Aft-peak tank	5,020	143.4
Double-bottom tank No. 1	6,728	192.2
Double-bottom tank No. 2	9,680	276.6
Double-bottom tank No. 3	7,170	204.9
Double-bottom tank No. 4	7,859	224.5
Double-bottom tank No. 5	9,513	271.8
Double-bottom tank No. 6	4,932	140.9
Total	55,109	1,574.5

FEED-WATER CAPACITY

	Cubic Feet	Tons Fresh Water
Double-bottom tank No. 6	4,932	137.0

FRESH-WATER CAPACITY

	Gallons	Tons
Drinking water	6,600	24.60
Daily supply tanks	300	1.11
After-peak tank	32,248	120.2
Total	39,148	145.91

The anchor chain is 2¼-inch stud link cable operated by a 10-inch by 10-inch spur-geared windlass located on the forecastle deck.

Hough Type Wooden Ships Prove Successful

THE successful adoption of certain soft wood construction to vessels of moderate size has been demonstrated in the case of two ships designed by Edward S. Hough, consulting engineer, San Francisco, and built on the Pacific Coast. A typical construction is the *Johanna Smith*, a vessel used efficiently as a lumber carrier. When without cargo, the holds are used as deep tanks, and in months of service no weak points have developed from carrying loose water ballast in them. One of the greatest points of strength in the hull is the double bottom arrangement, which combines lightness with great strength. The ships have proved very steady in a seaway.

The *Johanna Smith* was built to the following specifications:

Length overall	268 feet
Length between perpendiculars	256 feet
Molded beam	49 feet
Beam over planking	49 feet 11 inches
Molded depth	20 feet
Deadrise	3 feet

The cargo space is divided into six holds by two continuous longitudinal wing bulkheads, four transverse and one centerline bulkhead. These holds are about 14 feet clear depth. Four hatches 37 feet by 14½ feet, and two hatches 32 feet by 14½ feet, give ready access to the cargo spaces.

The propelling machinery, boilers and auxiliaries are all aft. Two oil-burning Babcock & Wilcox watertube boilers with superheaters supply steam at 225 pounds pressure to two De Laval turbines, each developing 750 brake horsepower. The turbines are geared independently to twin screws. The boilers are installed on the main deck, while the turbines, condenser, air pump, simplex feed pumps, centrifugal circulating pump and fuel oil tanks are in the hold. A simple mechanical draft arrangement preheats the air by passing it under the ash pit.

The auxiliary equipment includes two direct-coupled 10-kilowatt steam-driven generators and a steam-driven ice machine, refrigerating a two-section cooling room. The steering gear is of the steam quadrant type, with hand-operating gear on deck directly overhead. Two repeating telegraphs are cross-connected from the bridge to the engine room.

The deck machinery includes two steam capstans on the forecastle head, two on the poop deck and one steam-driven anchor windlass.

The officers' quarters are arranged on the poop deck and above, while the oilers, firemen and waiters are housed aft on the main deck. The deck crew is quartered in a raised forecastle forward.

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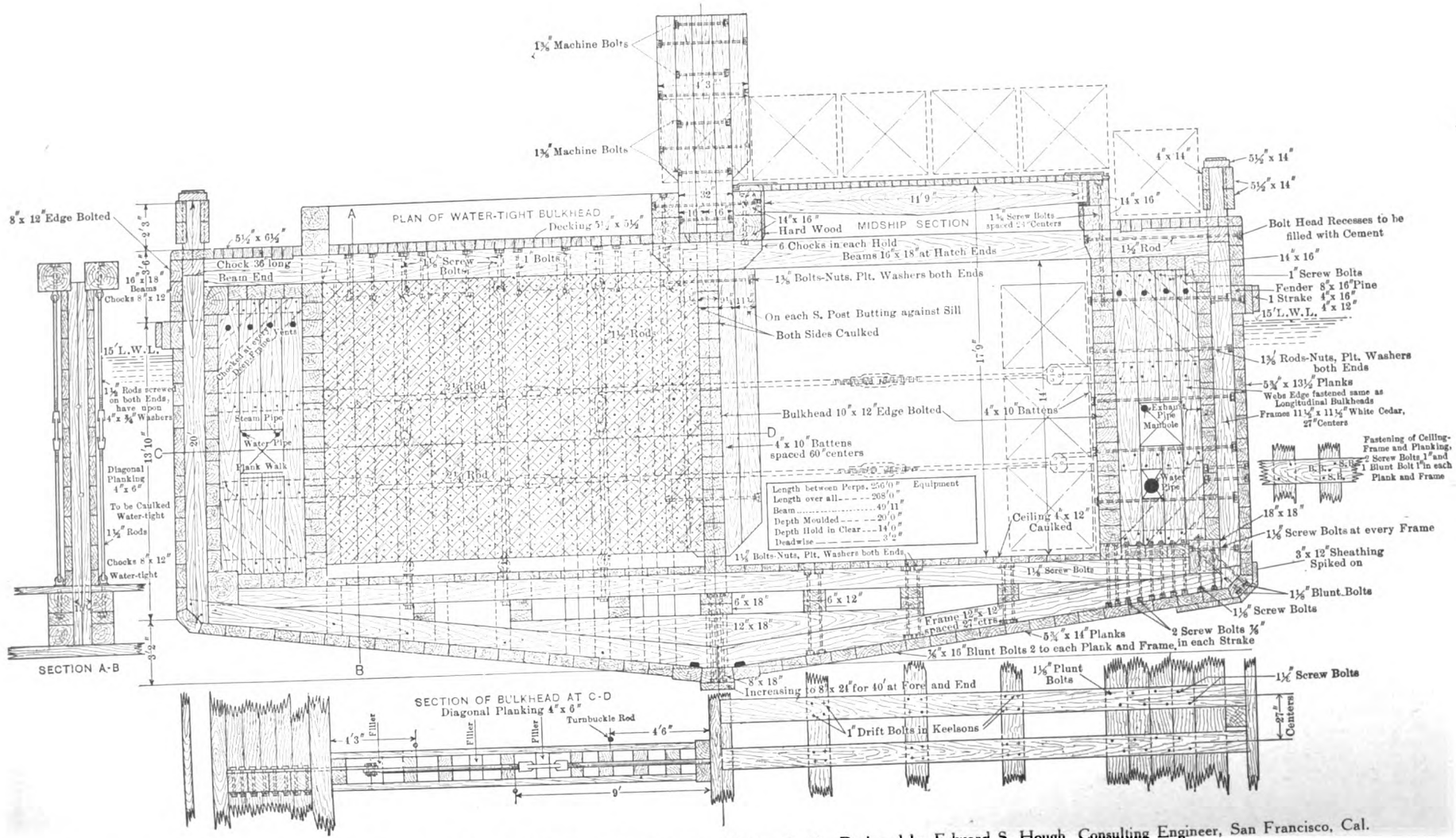

Fig. 2.—Midship Section and Sections Through Bulkhead of Wooden Cargo Steamer *Johanna Smith*, Designed by Edward S. Hough, Consulting Engineer, San Francisco, Cal.

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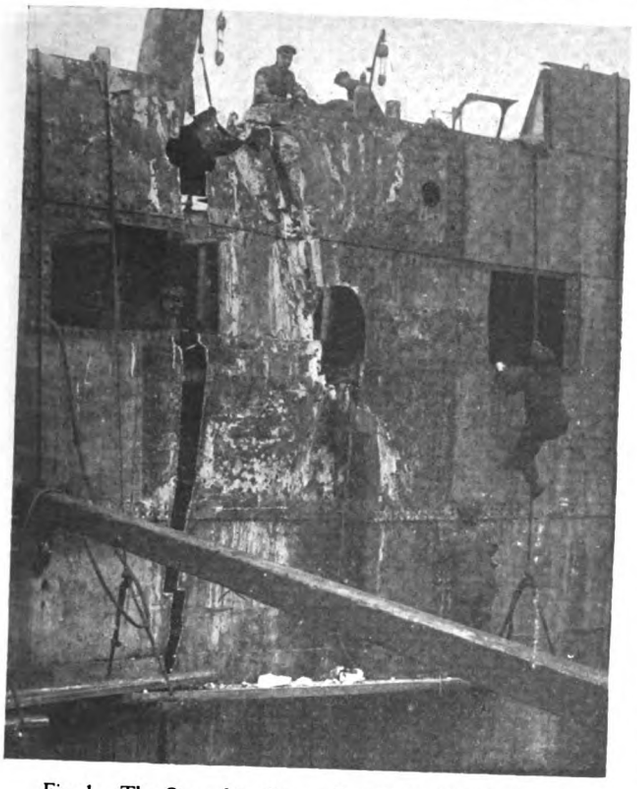

Fig. 1.—The Steamship *Curaca* Practically Split in Half

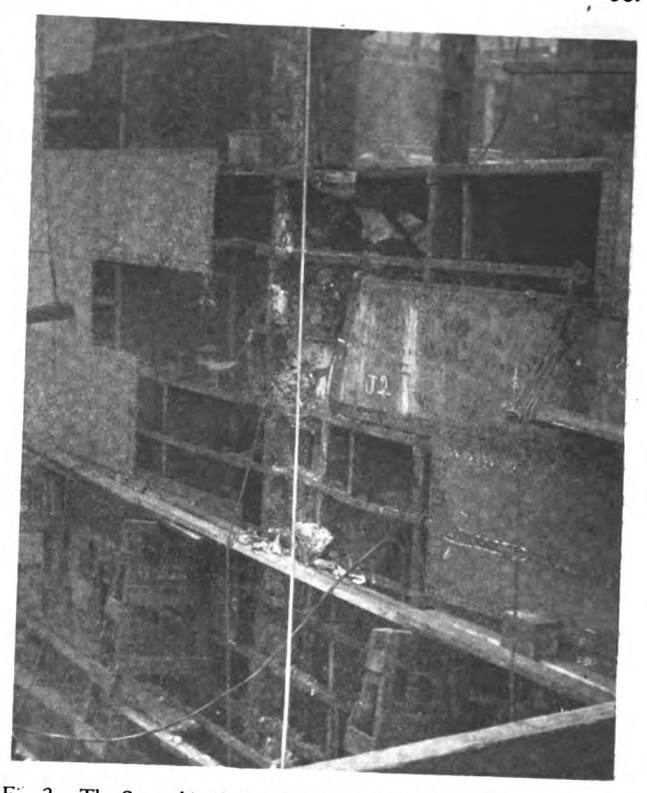

Fig. 2.—The Steamship *Curaca* 24 Hours After She Was in Dry Dock

The ship has a speed of 9½ knots under full load, and in this condition has a mean draft of 17 feet. With suitable wharf-crane equipment, it is possible to either load or unload a cargo of 1,400,000 feet of lumber in ten hours.

Similar type ships have given satisfactory service throughout the war period, carrying general cargo.

Unique Engineering Feat

THE repair of the steamship *Curaca* is one of the strangest ever attempted in American yards. The work was carried out by the Robin's Drydock and Repair Company, Brooklyn, N. Y.

The *Curaca* was sunk during the explosion in Halifax Harbor. Her superstructure was blown away, and she buckled at about the mid-length to such an extent that when refloated the draft at this place was 16 feet 2 inches, while the draft at the bow was 7 feet and at the stern 9 feet 8 inches, showing that the vessel was forced up 9 feet 2 inches from the base line at the bow, while the stern was forced up 6 feet 6 inches.

In this condition the vessel was raised, temporarily repaired and brought back to New York under her own steam, and the work of straightening and repairing commenced on April 25, 1919.

The big problem here was to restore the vessel to an even keel. On a preliminary survey this seemed to be impossible. Further examination was made, and finally a plan was outlined which subsequently proved successful.

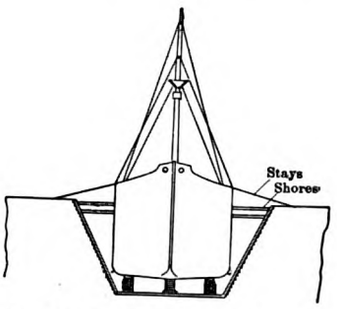

Fig. 4.—Section Through Drydock

The report of the work is of interest, and reads as follows:

Keel blocks were set solid for a length of thirty-six feet, as it had not been determined exactly where the buckle was located. On April 25, the vessel was warped into number 2 graving dock, at the Robin's plant, placed

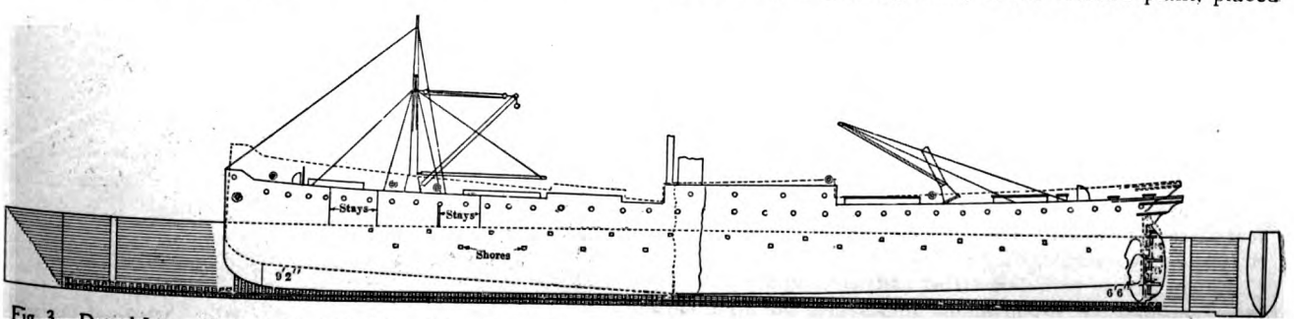

Fig. 3.—Dotted Lines Show Original Position of the *Curaca* in Dry Dock Before Water Was Pumped Out and Sides of Vessel Cut Apart

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over the blocks and plumbed up. Shores from each side of the dock were then set in place against the sides of the vessel. Wire hawsers were extended from each side of the deck and made fast ashore, so that there would be no danger of either the forward or after section listing, if a break should result at the buckle point before the straightening of the vessel was completed.

The dock pumps were then started. As soon as the buckled area of the keel touched the blocks the pumps were stopped and an examination made to see that the vessel was perfectly upright and over the blocks. The sides of the vessel were then gradually cut at the buckle from the deck to the waterline on both sides. The pumps were again started, and as the dock was slowly freed from water the cutting was continued about 6 inches at a time.

Close observation showed that as the cutting of the plates and the pumping out of the water progressed the ends of the *Curaca* dropped gradually, being without the support of the blocks. During this operation frequent inspections were made to determine that both the forward and after sections were upright, and the hull had not twisted and that no structural change had resulted. When the dock had been pumped dry the entire keel of the *Curaca* rested on the blocks.

This operation was begun at 7:30 A. M. and was successfully completed at 3 P. M. the same day.

The bottom plating around the buckle had fractured, due, probably, to the vessel having worked at this point. The bottom of the *Curaca* was also damaged in the explosion to such an extent that 54 of her bottom plates needed to be repaired and renewed.

Russian Railroad Equipment Stored in Seattle Railway Yards

American Vessels Carry 70,000 Tons of Russian Railroad Equipment

THE trans-Pacific steamships of the United States Shipping Board are now transporting to Vladivotock, Siberia, for the Russian Mission of Ways of Communication, seventy thousand tons of railroad rolling stock, which have previously been stored on a twenty-acre stretch of land near the railroad yards south of Seattle, Wash., and barred from shipment across the Pacific Ocean. The material is finally being removed as rapidly as possible, with the consent of Government authorities.

More than three years ago Czar Nicholas of Russia sent to the United States a special party of transportation and railroad experts to purchase machinery and supplies which would assist in opening a vast area in Siberia to railroad travel. The expedition purchased seventy thousand tons of railroad stock, including knock-down railroad coaches, locomotives, engines, wheels and various other railroad parts. This big supply was shipped across the continent to Seattle, where it was stored in railroad yards preparatory to being transshipped across the Pacific Ocean to the Siberian port of Vladivostock. America's entrance into the world war, however, prompted Government officials to delay shipment until additional steamships were available. Then came the internal strife in Russia, the overthrow of the Czar, the victory of the Bolshevik armies and the turmoil which began to rage even as far east in the Russian Empire as Siberia.

With conditions adjusted in Siberia, a request was served on the American Government by M. Kagansky, Seattle representative of the Russian Mission of Ways of Communication, to release the railroad supplies. After investigation, the Government forwarded the first shipment of more than 8,000 tons in May, 1919, on the steamship *West Helix*, a 9,800-ton steel vessel built in Seattle. Since that sailing several other ships have loaded the stock for Vladivostock. Probably the entire supply of 70,000 tons will have been delivered across the ocean at the end of the year.

British Admiralty Cancels Orders for 326 Vessels in Eight Months

Since the signing of the armistice the British Admiralty has cancelled orders for 326 vessels, resulting in a net saving of $200,000,000 (£42,000,000). When the armistice was concluded there were 302 war vessels and 806 auxiliaries under contract by the Admiralty. At the present time there are being completed 84 war vessels and 110 auxiliaries, mainly to replace old ships or to meet the ravages of war.

American Vessel Taking on Cargo of Russian Railroad Equipment

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Uniform Cost Accounting in Shipbuilding

Plan Adopted by the Atlantic Coast Shipbuilders' Association for Uniform Methods of Cost Accounting in Steel Shipbuilding

BY J. L. JACOBS*

RETENTION of the present position of the United States in the world's shipbuilding programme makes it imperative that shipbuilders adopt methods of cost control and operating efficiency with assurance of sane and intelligent competition. Through this means the individual shipbuilders and the shipbuilding industry as a whole will not be made to suffer from quotations and production based upon inadequate or insufficient cost and production data. At the same time, opportunities will be opened for increased profits and stimulation for greater production, and lower costs should result.

The United States Shipping Board Emergency Fleet Corporation and the Atlantic Coast Shipbuilders' Association have directed the attention of shipbuilders to the importance of adequate and accurate cost finding methods as one of the mediums for increased production and lower costs in shipbuilding. The work of developing uniform methods of cost accounting which might be applied to any type of yard was undertaken by a joint committee from the Atlantic Coast Shipbuilders' Association and the United States Shipping Board Emergency Fleet Corporation with co-operation by the shipyards of the Great Lakes district. Since the approval by the association and the Emergency Fleet Corporation of the general plan of uniform cost methods which is outlined herewith, another important step has been taken by the Atlantic Coast Shipbuilders' Association, which comprises all the steel shipyards on the Atlantic and Gulf coasts, in the appointment of a committee of influential executives to promulgate and put into actual effect the methods recommended.

The wisdom and advantages of uniform cost finding methods in the huge and complicated business of ship manufacture is clear in the light of shipbuilding experiences before the war. The value of current cost statistics and comparable standards of operation in shipbuilding has been realized by a few of the shipyards. Stores' control and labor distribution are quite well advanced in these shipyards, and some basis for distribution of expense has been set up.

Many shipbuilders fully recognize the value of accurate and comparable cost figures as a means of establishing standards for estimating and for comparing operation efficiencies and for providing proper bases for production costs and selling prices.

Most of the other shipyards have little of what might be termed "cost keeping," and the practices of charging labor and materials and distribution of expense to departments and to jobs are not defined and are insufficient.

In most instances the value of the cost information which is compiled is of little significance and the data obtained are not related to any standards, so that the executives have little or no conclusive basis for controlling operation and production.

Advantages Derived from Proper Cost Methods

The more important benefits to be derived from the application of properly designed cost accounting methods, when applied uniformly in the various shipyards, briefly stated are as follows:

1. Reliable guide and basis for estimating prospective business.
2. Complete costs of specific articles and indicator of profitable and unprofitable production and service activities.
3. Gage of the value, efficiency and wastes of workers, machines, methods, operations and plants.
4. Uniform terminology enabling comparisons of progress and efficiency of production between units in shipyards and between groups of shipyards.
5. Supplementing of general accounts of shipyards with cost accounts and proving of accuracy of costs and adequacy of methods through general bookkeeping system.
6. Ease with which cost and progress figures may be arranged in a simple, tale-telling manner.
7. Control of operation and production standards through current periodic cost figures.
8. Visualization of business conditions by executives through logical arrangement of figures.
9. Insurance against unintelligent competition and unprofitable undertakings.
10. Current reports for comparing of major cost items with standards, which are predetermined, and measuring and increasing operating efficiency.
11. Co-operation and friendly competition resulting from cost comparisons.

Major Considerations in Devising Uniform Cost Methods

The primary object in the preparation of the standardized cost finding methods has been to develop the basic principles, definitions of cost elements and the nature of cost statistics applicable and useful to the various shipyards.

To establish uniformity in cost accounting, it was essential that standard methods be first established in the controlling items and divisions. These are of particular importance from the point of view of shipbuilding executives, who will be enabled currently to visualize production and operation conditions and to compare costs with standards in their shipyards, as well as with other shipyards.

The preparation of the plan of uniform cost finding methods was preceded by thorough examination of prevailing practices and methods and of the organization of some twenty-five shipbuilding companies (representing over sixty shipyards).

Examinations of the shipyard organizations, of the physical plants, and of the activities in the shipyards, bring out clearly the diversity and number of classes of activities and product units. At one extreme there are the shipyards which manufacture and fabricate their own hull steel and engines complete from basic raw materials and also manufacture much of the ship outfit. At the other extreme there are those shipyards which purchase complete engines, machinery, etc., as well as fabricated steel for hull, and buy much of the ship's outfit. Between these two extremes are numerous variations and modifications.

Any standardized methods of determining shipbuilding

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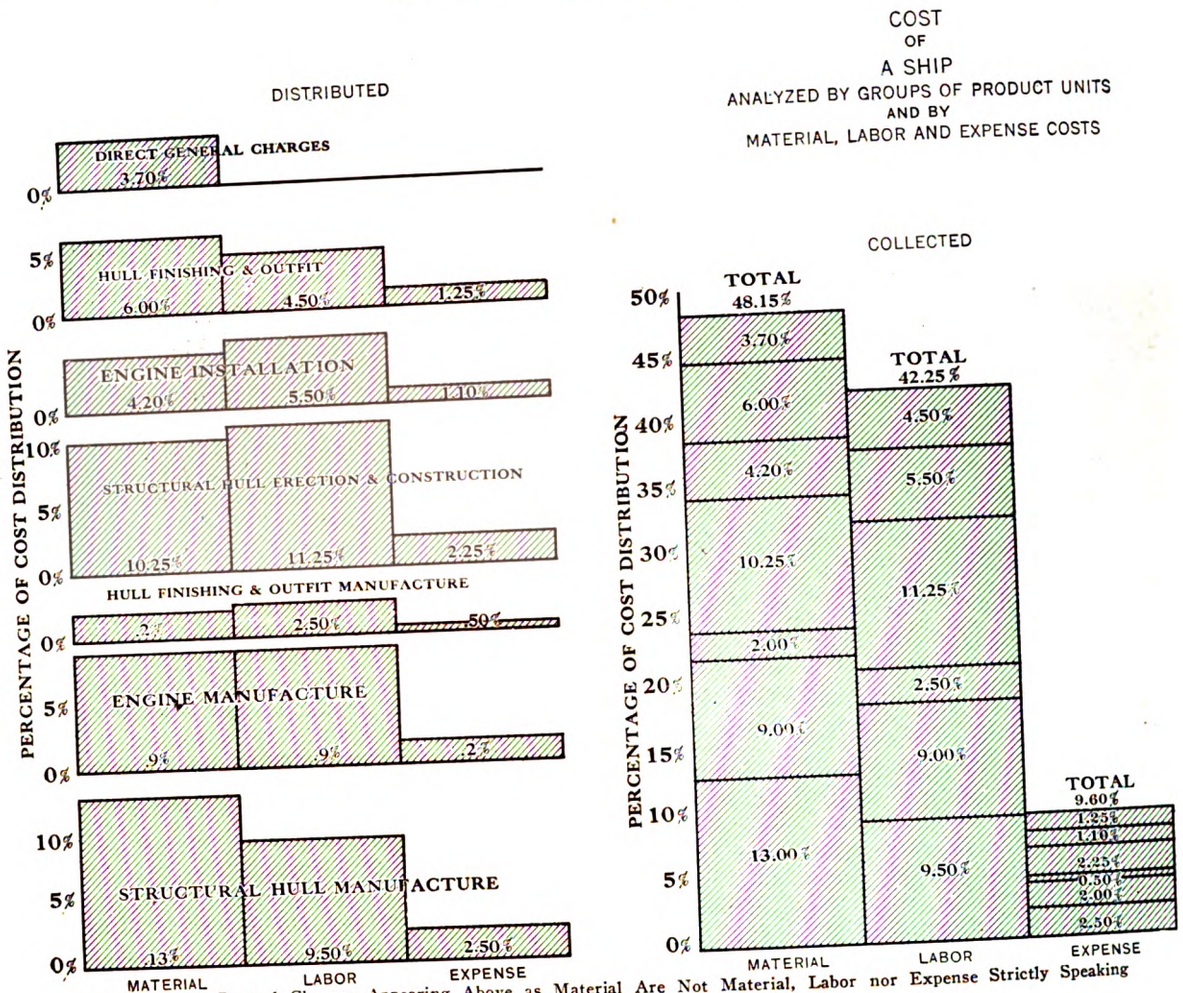

NOTE.—Direct General Charges Appearing Above as Material Are Not Material, Labor nor Expense Strictly Speaking

Fig. 1

costs which do not recognize the basic divisions and major differences in activities and products must of necessity be incomplete or superficial. The basic lines of distinction or classification must be so fundamental that they will be adaptable to the variations in activities and products which exist in any shipyard.

Cost methods consist essentially of the collection and arranging and applying of material, labor and expense charges to job accounts or contracts in a way that will furnish adequate costs and continuous control of production and operating efficiency. The first thing, therefore, in the development of standardized cost methods is to define the plant activities and product units and departments through which it is desired to collect charges, so that such charges will at all times be confined to the same items and so that there will be no confusion in the distribution and arrangement of the charges.

Classifications of the major activities, product units and departmental divisions in the shipyards for the purpose of uniformity in ascertaining and applying costs have been drawn up in such a way as to be applicable to all shipyards. Any individual plant can use those items which are applicable and omit those items which are not applicable. Also, each yard can, where desired, develop any detail subdivisions under each of the main divisions without in any way affecting the general classifications or the purposes of the standardized plan of cost accounting.

In the analysis of the information which was collected, certain main requirements were disclosed which are essential for effective cost methods, and these are developed in the proposed plan. These points or requirements consist of the following:

(a) Accuracy.
(b) Timeliness.
(c) Uniformity of Terminology.
(d) Uniformity of Cost Classifications.
(e) Uniformity in Expense Distribution.
(f) Standard Basis for Estimates.
(g) Definite Standards of Comparison.
(h) Standard Instructions and Procedure.
(i) Control of Stores and Labor.
(j) Cost Organization.

General Methods of Cost Finding

Broadly considered, there are two general methods of ascertaining and compiling costs. One of these is generally referred to as the "process method" and consists of the gathering and compiling of costs by processes. The cost of any product unit or article is equal to the total of the direct and indirect costs and expenses incurred in the processes through which the product passes. The process method of cost accounting is particularly applicable where the product is standardized and production consists of a series of definitely measured complete processes or operations.

The other general cost finding method is referred to as the "job order method." Where this method is used, cost charges are ascertained and applied against specific product units or jobs. The "job order method" is applicable

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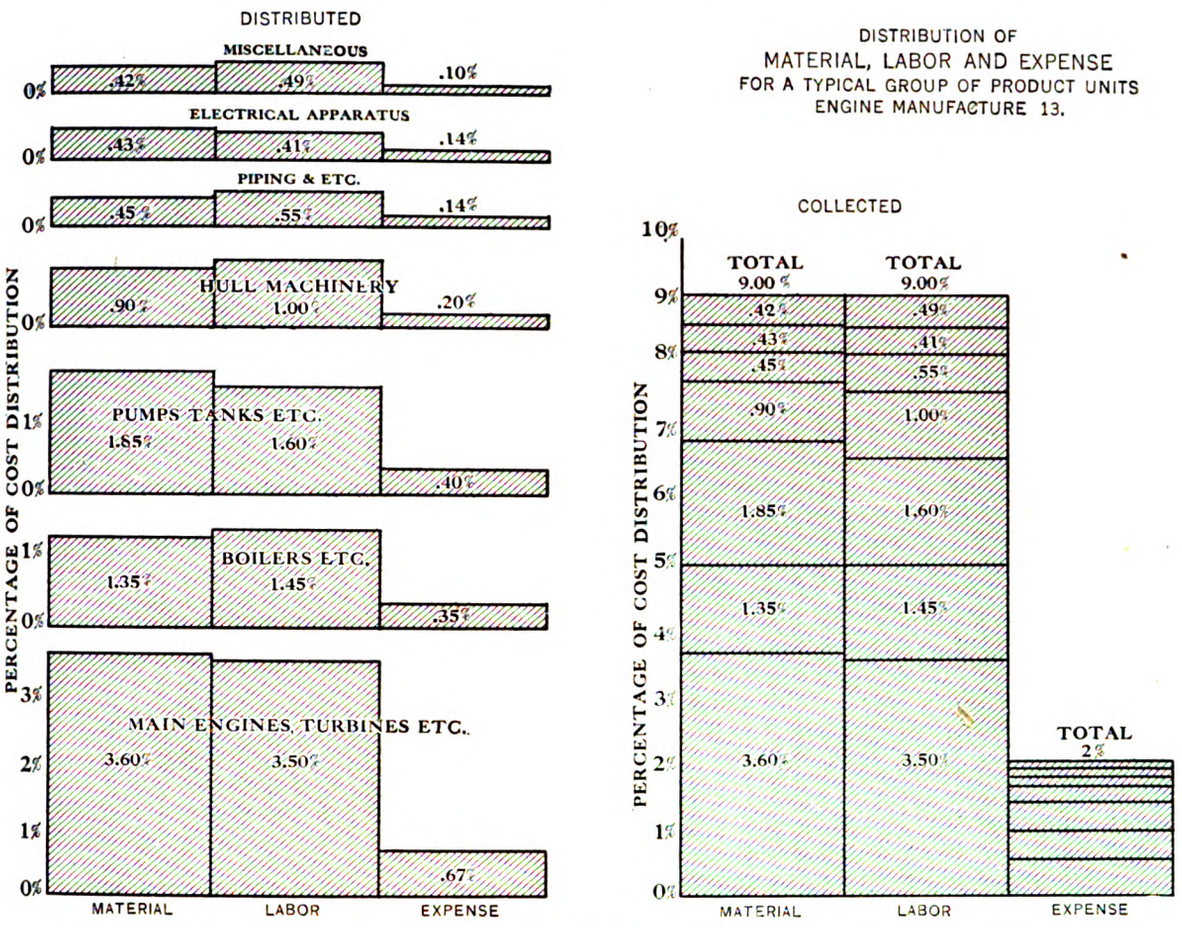

Fig. 2

where the product is not standardized, where the work varies considerably with different orders, or where production does not consist of a series of standard recurring processes.

Of the two general methods, the "job order method" is clearly the standard method which can best be applied to the various activities in the shipbuilding industry. In a general way, the job order method was the one in use at the time of the examinations in most shipyards, although there were many variations from the standard methods adopted in the uniform plan.

Classification of Shipyard Work

The main activities of shipyard work are included under a series of shipyard production orders. The classification of production orders includes all the distinct shipyard activities, and distinguishing order numbers constitute the method of identifying these different classes of work.

Each order authorizing work is given a production order number by which that job is thereafter known and distinguished from all other orders. The production or job order number will facilitate in comparing all the elements of cost, in tracing the costs which are applicable to any job, and in classifying the production work done in the shipyard.

The main series of shipyard production orders has been designed so as to be applicable to any shipyard. The series may be amplified or reduced without affecting the general plan. The production order classification and definitions of each of the main classifications are as follows:

1. *Construction Orders—Ships* are used on all orders for the production of a ship entire, including the steel hull, machinery, and finishing and outfit.
2. *Construction Orders—Ship Product Stock* are used for all orders for the production of ship materials, parts or equipment (other than by auxiliary and stock manufacture departments) where the product is to go into stock.
3. *Construction Orders—Special Contracts* are used for all special orders of ship production where only parts of the entire ship or all work of special ship construction are included.
4. *Auxiliary and Stock Manufacture Orders* are used for all orders for work by auxiliary and stock manufacture departments.
5. *Defective Work Orders* are used for all orders in connection with defective work or for correction of defects in any articles or products manufactured.
6. *Vessel Repair Orders* are used for all orders for ship repair work.
7. *Construction and Betterment Orders—Plant and Equipment* are used for all orders for new construction or betterments on plant or equipment, which improvements are permanent in nature and add to the capital investment of the plant.
8. *Repairs and Maintenance Orders—Plant and Equipment* are used for all orders on general repair and maintenance work on buildings, machinery, equipment, fixtures or tools, which work does not affect the capital investment of the plant, the

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cost of which work is either charged to depreciation reserve or is a part of productive, general works or general administrative expenses.

9. *Miscellaneous Orders* are used for all production orders not included in any of the above (include material, labor and expense for others).

SHIP PRODUCT UNITS' CLASSIFICATON AND METHODS

Under each class of production orders there are the product units upon which complete costs should be gathered and to which charges should be made for material, labor and expense costs. It is thus seen that the cost for any particular production order is the sum of the material, labor and expense costs of each of the product units.

Analysis of the organization and functions in shipyards, which was made for the purpose of determining the basic divisions in shipyard work, has led to the definite conclusion that the basis should not be location, i. e., a classification as between work in the shop or work in the field (yard). It is also clear that, for purposes of uniformity in methods and comparative cost figures as between shipyards, the basis of the shipyard product divisions should be more elemental than the ship parts basis, i. e., distinction between the hull, machinery and outfit.

The division, which will permit of proper standardized methods in cost finding and which is practical of application in shipbuilding is based on the functional division of shipyard work into two primary classes into which shipyard activities group themselves, namely:

1. Manufacture of Ship Parts.
2. Ship Construction and Machinery and Outfit Installation.

Manufacture of ship parts includes all work and operations involved in fabrication or machining, or other work to put raw materials or component parts into a state where such parts are ready for assembling and ship construction. This division also includes all work and operations involved in the manufacture of raw materials (except work in stock manufacture) or such component parts which become a part of engines, machinery, piping and ship outfit and other ship parts where they are ready for installation in the vessel.

Ship construction and machinery and outfit installation includes all work and operations involved in assembling and erection of steel hull, all steel work on hull, all wood work and the installation of engines, machinery and fittings outfit and finishing and the work in the delivery of the vessel to the owner.

The primary functions, (1) manufacture of ship parts and (2) ship construction and machinery and outfit installation, naturally divide themselves into subdivisions based upon divisions of hull and the parts or groups of engines, machinery, outfits, etc. Each subdivision or group in turn consists of a number of similar units of specific parts which, when assembled with other units, make up the group.

The main subdivisions of each of the primary functions are as follows:

1. Structural Hull.
2. Machinery.
3. Hull Finishing and Outfit.

The product units constitute the job accounts to which all direct charges of labor and material and the distribution of expense should be made. These job accounts or product units will thus be the basis of the outlines for cost summaries and cost estimates, as well as for the payment for work completed.

In addition to these main subdivisions, there is included under the main division of ship construction and machinery and outfit installation the group of accounts which cover the direct charges which are of a general character. These accounts consist of such expenses as insurance and classification fees, cost of staging, shoring and fairing, testing and inspection, launching and entertaining, trials and delivery, etc., as are incurred on any job or contract, and should be applied directly to the job account or contract.

The principal divisions of the ship product unit classification are therefore as follows:

1. Manufacture of Ship Parts.
   - 11. Structural Hull Manufacture.
   - 13. Machinery Manufacture.
   - 15. Hull Finishing and Outfit Manufacture.
   - 17. Auxiliary and Stock Manufacture.
2. Ship Construction and Engine and Outfit Installation.
   - 21. Structural Hull Erection and Construction.
   - 23. Machinery Installation.
   - 25. Hull Finishing and Outfit.
   - 27. Direct General Charges.

Definitions of each of these groups and subdivisions make it certain that all shipyard organizations will interpret the control divisions in a uniform way. Detail classifications are also provided under each of the main heads, but are not carried to such a point as to restrict shipbuilders in their treatment of specific items.

DEPARTMENTAL CLASSIFICATION AND EXPENSE DISTRIBUTION

For purposes of proper gathering and distribution of expense or overhead, and for closer control of the elements of costs and of production, all costs should, in so far as it is possible, be gathered and applied to job accounts or product units through the respective departments. A charges and will serve as a valuable means of operating through the departments will furnish more accurate cost charges and will serve as a valuable means of operating and efficiency control.

Charges are made to job accounts for product units for labor, material and expense. The direct labor charges against the job accounts are reported through the department and the labor changes thus secured are used as a basis for distribution of expense to the various job accounts or product units. The departmental classification thus had its greatest use in connection with the distributing and compiling expense costs to the product units or job accounts.

The main divisions of the departmental classification consist of the following:

1. Productive Departments.
2. General Works Departments.
3. General Works Distributive Departments.
4. Auxiliary and Stock Manufacturing Departments.
5. General Administrative Departments.

Under each of the above divisions are set out the typical departmental organizations which are ordinarily found in a shipyard. In those cases where there are more than one shipworks, each plant will be given a separate plant number or other distinguishing code designation, and this designation will be used with the departmental code designation for reporting and ascertaining costs and for proper expense distribution.

OUTLINES OF COST STATISTICS

A graphic representation of the general plan of collecting, arranging and analyzing elements of production costs as applied to steel shipyards is shown on the chart on this

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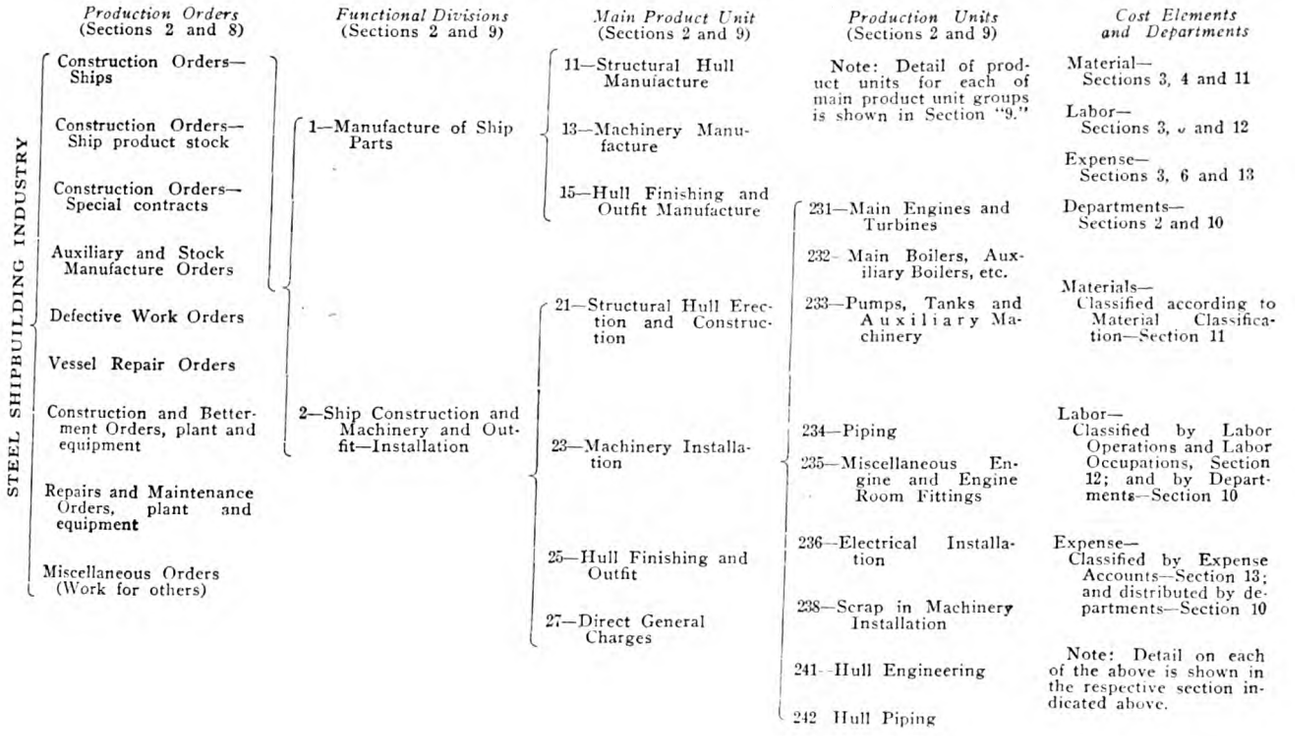
GRAPHIC ILLUSTRATION OF PLAN FOR COLLECTING, ARRANGING AND ANALYZING ELEMENTS OF SHIPYARD PRODUCTION COSTS

Report and Recommendations on Uniform Methods of Cost Accounting in Shipbuilding. Compiled for Committee on Uniform Methods of Cost Accounting, Atlantic Coast Shipbuilders' Association, by J. L. Jacobs & Company, Chicago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Note: Detail on each of the above is shown in the respective section indicated above.

page. This exhibit makes clear the building up of summary cost statistics for each type and class of wrok which is done in a shipyard through the series of production orders. It will be noted that costs are obtained and compiled for each of the production units through different job accounts. The cost of the main product unit group is a sum of the costs of its product units. Likewise, the cost of the production order is a sum of the cost of the main product unit groups. The cost of all direct materials, direct labor and expense are ascertained and compiled for each product unit.

In the two other exhibits (Figs. 1-2) is shown the general plan of ascertaining the cost of a ship analyzed by groups of product units and by material, labor and expense costs and the distribution of material, labor and expense for a typical group of production units.

It will be noted on these charts that the horizontal sections represent the product unit groups of a ship, such as structural hull manufacture, engine manufacture, hull finishing and outfit manufacture, structural hull erection and construction, etc., and the vertical divisions represent the cost elements of direct material, direct labor and expense. Direct material, direct labor and expense are shown for each production unit and in total.

These exhibits have been drawn for the purpose of visualizing cost analysis and distribution, and do not presume to show the actual proportions of costs found in practice.

The general methods of cost finding in steel shipbuilding are thus briefly summarized as follows:

1. Costs are ascertained and compiled for every type and class of work which is done in a shipyard through the several series of production orders.
2. Costs are obtained and compiled for each of the product units through the different job accounts. Thus the cost of a production order is the sum of the cost of the product units.
3. The cost of each product units is ascertained and compiled under the three main elements of cost, namely, direct labor and direct material charged directly to the product unit and expense, apportioned to it.
4. For purposes of compiling and proving direct charges and uniform expense cost to production and securing control over all costs, definite departmental divisions and designations are used.
5. Costs are treated with definiteness and uniformity through standard classifications of the controlling divisions.
6. Definite cost figures under each of the job accounts or product units supply standards for use in estimating and measuring production progress and operating efficiency.
7. Control of all work in process and stores through the general ledgers.

(*To be concluded.*)

Shipbuilding in Scotland

Shipyards in Scotland during the month of June launched 44 vessels aggregating 90,587 tons. Of the vessels, 38 of 83,907 gross tons were built on the Clyde, three of 4,900 gross tons on the Forth, one of 1,390 gross tons on the Tay, and two of 400 tons on the Dee. The Clyde output was the second largest among those of the months of this year. The Clyde total of 264,806 gross tons for the half-year is practically as high as the total for the corresponding period of 1914 and represents a total very well up to the average of pre-war years. Most of the vessels launched in June were large merchant steamships for private owners.

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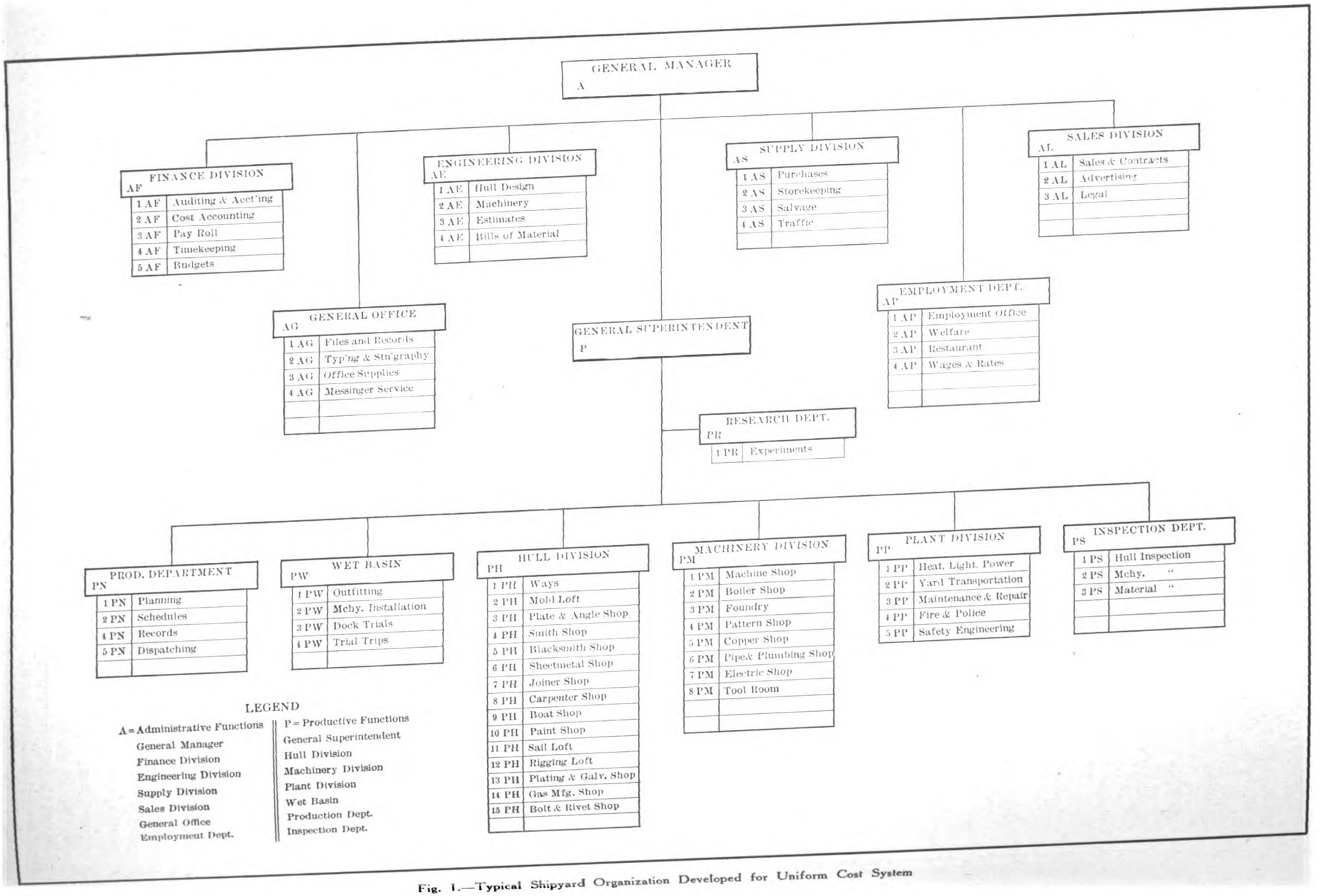

Fig. 1.—Typical Shipyard Organization Developed for Uniform Cost System

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A Cost System for Shipyards—II

Development of a Cost System—Method of Organization—Symbols Used in Collecting Cost Data

BY CREIGHTON CHURCHILL*

In addition to the definition of the cost and structural classification, it is necessary for analytical cost purposes to provide some simple means of identifying current activities of production centers with the general scheme so that as little effort as possible will be expended in collecting cost data. This is best done by a system of mnemonic symbols in combination with a scheme of workmen's numbers by which costs are allocated first to the production center or shop and then to the particular craft or trade in that production center.

Organization, Symbols and Employee's Numbers

All industry, of whatever nature, is carried on and directed by some sort of an organization patterned on lines which provide more or less thoroughly for the execution of all the functions involved. In addition, the activities of any manufacturing industry can be separated into two general functions, namely, administrative and productive or operative. Under each of these general functions a further subdivision into other and more detailed functions may be made, depending on the nature of the industry. As these activities are controlled through the proper functioning of certain subdivisions of the organization, it seems logical to take the plan of the organization as a basis for collecting data necessary to the conduct of the business. Working from this point of view, and avoiding the pitfall of collecting data under various methods which have no intimate direct connection with each other, accurate, adequate and timely information is sure to be secured at a minimum cost. It is simply a case of working from a general plan down to the details rather than from the details up to several independent plans and then combining these independent plans to form a general plan. It is obvious that the former method is the more logical way, on the theory of reasoning from cause to effect, to approach a problem.

In order to make the basis for the development of a uniform cost system quite clear and put it before shipyards in such a way that it can be used without the necessity of changes in individual organizations, a typical shipyard organization has been drawn up. Incidentally, this typical organization is a composite result of the organizations existing in over 50 percent of the steel yards of the country.

The key to the method of symbols is based on the assignment of a letter or combination of letters and numbers to each of the various divisions and subdivisions of the organization so that each symbol will be indicative of the part of the organization to which it refers. For example, the letters *A* and *P* are assigned to the general administrative and productive functions respectively, the letters *H* and *M* to the hull and machinery divisions respectively, and so on. A combination of such letters with a number prefixed serves to identify the various subdivisions, as *1PH* for the ways and *3PM* for the foundry. The following tables and the chart, Fig. 1, will make this perfectly clear. In the tables the stores symbols are provided to meet requirements which will be described later.

*Member of firm of Churchill & MacLeod, New York.

A. *Administrative*—Chief executive in direct charge.
- M. Management Division—General officers and general supervision.
- E. Engineering Division—Hull and machinery design and specifications, material lists.
- S. Supply Division—Purchases, salvage, stockkeeping, traffic.
- F. Finance Division—Auditing and accounting, costs and estimates, payroll, timekeeping.
- L. Sales Division—Sales, contracts, advertising, legal.
- P. Employment, welfare, restaurant.
- G. General Office—Files, records, typing, stenography, supplies.

P. *Productive*—Works manager or general superintendent in direct charge.
- H. Hull Division—Ways and shops.
- M. Machinery Division—Shops.
- P. Plant Division—Power house, yard transportation, maintenance, safety.
- N. Production Department—Planning, schedules, dispatching, records.
- S. Inspection department—Hull, machinery, materials.
- W. Wet Basin—Outfitting, machinery installation, trial trips.
- R. Research Department—Experiments, new tools and equipment, tests.

M. *Material*—General storekeeper in direct charge.
- T. Contract Stores—Stores to specified contracts or jobs.
- R. Raw Material Stores—Pig tin, copper, pig iron, sheet metal, etc.
- S. Steel Stores—Plates, shapes.
- L. Lumber Stores—Ways, carpenter, joiner, pattern.
- P. Shop Stores—Shop supplies.
- G. General Stores—Fuel, building materials other than lumber, etc.

A. *Administrative*

AM—Management Division.
- 1AM—General officers.
- 2AM—General supervision.
- 3AM—Miscellaneous expense.
- etc.

AE—Engineering Division.
- 1AE—Hull drafting and estimates.
- 2AE—Machinery drafting and estimates.
- etc.

AS—Supply Division
- 1AS—Purchases.
- 2AS—Storekeeping.
- 3AS—Salvage.
- 4AS—Traffic.
- etc.

AG—General Office.
- 1AG—Files and records.
- 2AG—Typing and stenography.
- 3AG—Office supplies.
- etc.

AF—Finance Division.
- 1AF—Auditing and accounting.
- 2AF—Cost accounting.
- etc.

AL—Sales Division.
- 1AL—Sales and contracts.
- 2AL—Advertising.
- 3AL—Legal.
- etc.

AP—Employment Department.
- 1AP—Employment office.
- 2AP—Welfare.
- 3AP—Restaurant.
- etc.

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P. *Productive*

PH—Hull Division.
- 1PH—Ways.
- 2PH—Mold loft.
- 3PH—Plate and angle shop.
- 4PH—Smith shop.
- 5PH—Blacksmith shop.
- 6PH—Sheet metal shop.
- 7PH—Joiner shop.
- 8PH—Carpenter shop.
- 9PH—Boat shop.
- 10PH—Paint shop.
- 11PH—Sail loft.
- 12PH—Rigging loft.
- 13PH—Plating and galvanizing shop.
- 14PH—Gas manufacturing shop.
- 15PH—Bolt and rivet shop.

etc.

PM—Machinery Division.
- 1PM—Machine shop.
- 2PM—Boiler shop.
- 3PM—Foundry.
- 4PM—Pattern shop.
- 5PM—Copper shop.
- 6PM—Pipe and plumbing shop.
- 7PM—Electric shop.
- 8PM—Tool room.

etc.

PW—Wet Basin.
- 1PW—Outfitting.
- 2PW—Machinery installation.
- 3PW—Dock trials and trial trips.

etc.

PP—Plant Division.
- 1PP—Heat, light and power.
- 2PP—Yard transportation.
- 3PP—Maintenance and repair.

etc.

PN—Production Department.
- 1PN—Planning.
- 2PN—Schedules.
- 3PN—Dispatching.
- 4PN—Records.

etc.

PR—Research Department.
- 1PR—Experiments.

etc.

PS—Inspection Department.
- 1PS—Hull inspection.
- 2PS—Machinery inspection.
- 3PS—Material inspection.

etc.

M. *Materials.*
- MT—Contract stores.
- MR—Raw materials.
- MS—Steel stores.
- ML—Lumber stores.
- MP—Shop stores.
- MG—General stores.

etc.

The numbering system for employees is arranged so that the numbers are tied in with the symbols in such a way as to indicate the unit of the organization to which an employee belongs. Obviously this simplifies the preparation of payrolls by units which is necessary for comprehensive cost analyses and is of material assistance in compiling costs by trades or crafts where desirable. This is further simplified by the use of tabulating machines, as will be seen later.

Administrative

All numbers assigned to consist of three digits and run from 100 to 299, with division letters prefixed.

Examples:

1AE 001 1AE 299—Hull drafting and estimates.
2AS 001 2AS 299—Storekeeping.
3AS 001 3AP 299—Restaurant.

etc.

Productive

Direct Labor.—All numbers assigned to consist of four digits from 1000 to 9999 with shop or department symbol prefixed, with certain series assigned to certain trades or occupations, as may be desirable. Gang foremen, quartermen and leading men go with their respective trades.

Examples:

Ways—
- 1PH 1000 to 1PH 1999—Riveting gangs.
- 1PH 2000 to 1PH 2999—Chippers and calkers.
- 1PH 3000 to 1PH 3999—Drillers and reamers.

etc.

Mold Loft—
- 2PH 1000 to 2PH 1999—Mold loftsmen.

etc.

Plate and Angle Shop—
- 3PH 1000 to 3PH 1999—Riveting gangs.
- 3PH 2000 to 3PH 2999—Chippers and calkers.
- 3PH 3000 to 3PH 3999—Drillers and reamers.

etc.

Machine Shop—
- 1PM 1000 to 1PM 1999—Machinists and helpers.
- 1PM 2000 to 1PM 2999—Machine operators.
- 1PM 3000 to 1PM 3999—Bench hands.

etc.

Boiler Shop—
- 2PM 1000 to 2PM 1999—Boiler makers and helpers.

etc.

Foundry—
- 3PM 1000 to 3PM 1999—Molders and helpers.
- 3PM 2000 to 3PM 2999—Coremakers and helpers.

etc.

and so on for direct labor in each shop or department.

Indirect Labor.—All numbers assigned to consist of three digits from 300 to 999 with the shop or department symbol prefixed, and certain series assigned to certain occupations. Supervisory indirect labor to be designated as above, except that series will run from 001 to 099.

Examples:
- 1PH 001 to 1PH 099—Ways supervision.
- 1PM 001 to 1PM 099—Machine shop supervision.
- 1PH 300 to 1PH 399—Ways office.
- 1PM 300 to 1PM 399—Machine shop office.
- 1PH 500 to 1PH 999—Way laborers.
- 1PM 500 to 1PM 999—Machine shop laborers.
- 3PP 500 to 3PP 999—Maintenance laborers.

etc.

Indirect labor or clerical help in the production divisional offices will be designated by numbers consisting of three digits running from 300 to 399, with divisional symbol prefixed.

Examples:
- P 300 to P 399—General superintendent's office.
- PP 300 to PP 399—Plant superintendent's office.
- PH 300 to PH 399—Hull division superintendent's office.
- PW 300 to PW 399—Wet basin superintendent's office.

etc.

It will be noted that a system of employees' numbers as outlined provides for a maximum of flexibility and for a considerable range in labor turnover without disturbing the general scheme. By readjusting the numerical series it can be made to fit the largest and smallest organization equally well.

The Development

Up to this point the discussion of the subject matter has been, in effect, an orderly arrangement of the contributing factors to a cost system, which is based on the nature of the shipbuilding industry. Should an actual installation of the proposed system be undertaken it is obvious that it would be necessary to go into greater detail, particularly in the arrangement of erection schedules and hull sections, in accordance with the structural classification. In fact, in this particular respect, it might be well worth while to consider a system of marking steel in accordance with the structural classification, so that each piece will carry its own identification from the storage yard to its place in the hull and enable the workman or timekeeper to read as

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he runs. This suggestion is made in the hope that it will receive careful consideration, as it is not deemed within the province of a paper of this kind to discuss piecemarks, due to the fact that it is not its purpose to suggest any radical changes in methods. At some future date the writer hopes to publish another paper dealing with this subject alone and pointing out the advantages to be derived from a change in the present methods of marking steel.

The entire purpose of any cost system is to tell a true story and afford the means of analyzing conditions to the end that executives will be in constant touch with things as they are. Consequently any such system should fulfill the following requirements:

1. Provide for all charges for direct labor and direct material.
2. Provide for all charges for indirect labor and indirect material, located at its source as far as possible.
3. Provide for overhead charges other than those in (2).
4. Provide for charges to structural classification.
5. Provide for charges to crafts where necessary or desirable.
6. Provide data for unit cost of all classes of output.
7. Provide data for estimating in accordance with structural classification.
8. Provide data for cost analyses.

It will be assumed that adequate work and material records are being made covering labor and material expended on construction, maintenance and repairs. In other words, that the time cards or work tickets, material orders, maintenance or repair orders, job orders, etc., contain all the information required and are practical as to form and use.

Using the typical organization as a basis for a cost system, it is clear that the division, department and shop symbols provide the means to allocate charges at their source, and, inasmuch as these symbols are all derived from the master symbol identifying the various sources of activity, a system is at hand for designating accounts such that charges automatically go where they belong. By prefixing numbers to the symbols, provision is made for subdividing the various charges under any main division to any extent desired. Reference to the chart will show this without further explanation.

It is a comparatively simple matter from one point of view to fill in the proper contract number, hull number or job order number, but from another point of view, that of the foreman, timekeeper or workman, it is not so simple. A scheme has therefore been evolved to eliminate as much as possible all of this difficulty and at the same time to give all the information possible. It consists of a series of numbers standing for certain classifications covering the activities of a plant to any desired extent. These numbers affixed to a shop symbol give a charge number so that anyone concerned having the key can make the charge to the proper account. In fact, the classification selected forms the basis for a series of standing orders which cover the activities of the entire working force. The classification taken, which is subject to extension, is as follows:

Standing Orders—Output

10. Main steel structure..... Labor and Material
11. Secondary structure..... " " "
12. Hull fittings..... " " "
13. Carpenter work..... " " "
14. Joiner work..... " " "
15. Cementing, painting and deck coverings ..... " " "
16. Operating equipment..... " " "
17. Furniture, furnishings and outfits ..... Labor and Material " " "
18. Hull machinery, hull engineering ..... " " "
19. Propelling machinery..... " " "

Etc.

Any items in the above classification which are purchased outside are to be charged, upon receipt, to the proper stores account until they are issued, at which time they are charged out to a charge number made up of the hull number, to allocate the charge to the proper hull, and the standing order number to cover the classification. For example, a windlass for Hull No. 17 would be entered on the material order as charged to 17-18 when issued from the stores, the labor for the foundations to 17-1PW-11, material for foundations to 17-11 and the labor for installation to 17-2PW-11. It will be noticed that material charges for direct material contain only a combination of the hull and structural classification numbers, while labor charges are made up of the hull number, shop symbol and the structural classification number. The object to be accomplished by this is to enable labor charges to be automatically separated from material charges for the purposes of cost analyses.

Standing Orders—Maintenance and Repairs

100. Land and appurtenances... Labor and Material
101. Buildings and structures... " " "
102. Plant appliances and equipment ..... " " "
103. Machinery and machine tools ..... " " "
104. Consumable supplies..... " " "
105. Losses and spoiled work... " " "
106. Salvage ..... " " "

Etc.

This maintenance or operating expense classification follows the same general idea as that for output, except that both labor and material charges are composed of the shop symbol and classification number, the distinguishing feature being that the classification number is always made up of three digits. For example, the labor for repairs to a locomotive crane would be charged to 2PP-102, as would also any material drawn from stores for such repairs. There would be no conflict with this charge, as the workman's time card or work ticket would indicate the labor costs and the material order would show the material. Again, labor and material for repairs to the roof of the foundry would both be charged to 3PM-101.

In all cases of maintenance charges the description of the work in the body of the repair order, work ticket or material order will enable the charge to be made to the individual machine, appliance or structure, as the case may be. The main object, however, is to classify all maintenance charges to shops in order to allocate operating charges at their source so that a check may be kept on fluctuations. For example, an analysis of a marked increase in the maintenance charged under classification 102 might develop that a certain locomotive crane was costing so much for repairs that it would be good business to scrap it and replace it with a new one.

Standing Orders—General Expense

1000. Executive and department head salaries.
1001. Clerical and drafting room salaries, except where latter can be charged direct to job.
1002. Indirect labor and material.
1003. Plant, builders' risk and liability insurance premiums.
1004. Taxes, ex-corporation and federal.

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1005. Depreciation.
1006. Rent of equipment, including power, light and heat.
1007. Registration, inspection fees, etc.
1008. Costs of molds, templates and designs when not chargeable direct to job.
1009. Reasonable allowance for spoiled work.
1010. Office expense, including supplies, telegraph and telephone service.
1011. Transportation for employees.
1012. Welfare work, including reasonable restaurant losses, if any.
1013. Necessary travel expense.
Etc.

It will be noticed that indirect labor and material are also covered under "standing orders—maintenance." This is intentional, as "standing orders—general expense" are for the general accounting and not for cost accounting. The cost accounting department reports all indirect labor and material charges within its jurisdiction as a lump sum to general accounting, and it, in turn, reports all other overhead within its jurisdiction to cost accounting for cost purposes. In connection with "standing orders—general expense," special attention is called to the charges excluded from overhead in the "definition of costs."

In some respects "standing orders—general expense" are foreign to cost accounting as far as the actual detail is concerned. They are mentioned here to provide a point of contact to merge cost accounting with the general accounts or vice versa. For the purpose of allocating at its source all the overhead possible, cost accounting is directly concerned with indirect labor and material. All other overhead is reported in a lump sum by general accounting and for cost purposes is distributed by cost accounting to the different sources of operating in the proper proportion. It has been suggested that this distribution be made either on a basis of direct labor or plant value at the sources of activity, whichever may seem the most equitable. The former will place it in proportion to actual work being performed at the different sources, which may vary for different periods, while the latter will be purely on a basis of value of structure and equipment. With capacity business on the books either way would seem fair. On the contrary, without capacity business either way would absorb all overhead, which is not good practice. This question of the distribution of overhead always appears in the consideration of costs, and in some industries has been satisfactorily disposed of through the method of machine hour rates. This latter method, however, does not appeal to the writer as suitable to the shipbuilding industry for several reasons, hence the following is offered as a suggestion:

When a plant is working to normal capacity direct labor is a good measure to represent the activities under such conditions. Under less favorable conditions direct labor will decrease to a point necesary to maintain the required output and again will be a measure for current activities. If, therefore, it is not considered good practice to charge idle equipment to overhead, it is equally unfair to charge other closely related items of overhead to current business. For example, it would be very ill-advised to jeopardize the organization by combining two department under one head due to poor business, yet, at the same time, it is well known that the business cannot stand the burden of the two heads unless conditions improve. On the other hand, if current conditions are used as a basis for going after more business, the overhead charges will be excessive and new business will not be attracted. Following out of this line of argument will lead to the only logical solution of this question, which is to standardize overhead, as well as other items of cost, on a basis of normal conditions, having due regard, of course, to changes beyond control. Having done so and accepting direct labor as a measure of current activities, the standardized overhead should be distributed in proportion to direct labor. For example, if the normal overhead of the fabricating shops distributed as heretofore outlined was a certain sum and current business on a direct labor basis showed but 60 percent of normal, then but 60 percent of this certain sum would be the current overhead charge against these shops. Bids for new business on such a basis should be much more successful than those based on absorbing all of the overhead irrespective of actual conditions. The absorption of undistributed overhead into profit and loss is a risk of the business, and the best way to reduce this risk to nothing is to make prices truly representative of actual costs. As a matter of fact, in the example cited, the profit and loss account would not have to absorb 40 percent of the standard overhead because the total overhead would naturally be somewhat reduced if a plant were operating at 60 percent of normal capacity.

Before leaving this matter it might be well to call attention to one item of expense that should not be charged to overhead, and that is selling and advertising expense. Applying the same line of reasoning, it will be seen that the expense of aquiring new business should not be charged to overhead until the business is secured, and certainly it should not be charged to business already on the books. While such expense will be charged eventually into final costs, it should be absorbed in the profit and loss account as a matter of good practice. This is based on the principle that market prices will stand a certain amount of this expense provided the business is secured.

(*To be concluded.*)

Port Facilities at St. Nazaire and Nantes

The development of the trade and industries of the lower Loire region depends entirely upon the improvements of the harbor facilities at St. Nazaire and Nantes, says Consul General G. Bie Ravndal in a recent issue of *Commerce Reports*.

St. Nazaire-Nantes is capable not only of becoming the chief port on the Atlantic coast of France, but also of competing with Belgian, Dutch and German ports for the commerce of central Europe.

Even now St. Nazaire receives ships of 15,000 tons, while Nantes accommodates vessels of 7,500 tons. There are docking, discharge, warehouse and railroad facilities to meet the needs of some 50 vessels of various dimensions at each place simultaneously. It should be noted that the building of docks, the deepening of the river, the installation of cranes and similar port works are constantly being pursued in accordance with the official programme as established by the law of July 7, 1913.

The chief drawback is the difficulty of obtaining return cargo, and, therefore, the growth of the port is dependent not only upon increased dredging operations, but also upon closer connections with inland sources of freight supply, including those of Alsace-Lorraine, as it is a question whether the iron ore, marble and other raw materials and manufactures available in the Loire Valley will even approximately solve the problem.

It is likely, however, that the momentum afforded by the war will continue to affect the fortunes of the St. Nazaire-Nantes port so that, after the departure of American transpors, it will still show an increase of business over pre-war conditions, and a marked tendency toward accelerated expansion.

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Diesel Engines and the Merchant Marine

What Motorships Have Accomplished on the Pacific Coast—Attitude of Shipowners Towards the Diesel Engine—Performance of the Libby Maine

IN an endeavor to answer the question: Why is the internal combustion engine not used more extensively for marine propulsion? the San Francisco Section of the American Society of Mechanical Engineers devoted its meeting of December 19, 1918, to a discussion of the Diesel engine as applied to the merchant marine, and the following report was published in *Mechanical Engineering*, the official organ of the society. The papers presented were chiefly a record of past performances of motorships on the Pacific Coast, but it was also pointed out that the internal combustion engines are rapidly assuming greater importance, and may ultimately replace the steam engine.

Bruce Lloyd, marine engineer for the Concrete Ship Section of the Emergency Fleet Corporation, discussed the attitude of the ship owner and gave valuable data of performances. George A. Dow, president of the Dow Pump & Diesel Engine Company, presented a paper on the Diesel oil engines of the motorship *Libby Maine*. Both of these papers are abstracted below.

J. H. Hanson, president of the Skandia Pacific Oil Engine Company, also read a short paper illustrated by about forty slides, covering the history and development of Diesel engines and showing some of the more recent installations on ocean-going vessels.

Perhaps the most interesting fact brought out by Mr. Hanson's remarks was the statement that there are nearly 800 motorships varying from 1,000 to 12,000 tons capacity now in operation. Some of these ships are making from 40- to 50-day continuous runs covering more than 10,000 miles and carrying cargo of 11,000 tons. These ships consume during such voyages 400 tons of fuel oil instead of the usual 1,500 tons of coal of the ordinary steamer, with a resulting saving of approximately 1,000 tons in fuel, and in addition making another thousand tons of cargo space.

Diesel Engines on the Pacific Coast

BY BRUCE LLOYD

The development of the steam engine, extending over a period of about one hundred years, has now reached such a stage that it is probably one of the most perfect machines that has ever been produced. The steam engine is wonderfully smooth-running and possesses great flexibility of power. And yet the ship owner is constantly being urged to discard his steam engine and install internal combustion engines, and for the simple reason that the steam engine is not complete in itself. Its future is doomed by its necessary adjunct, the steam generator, which has never been improved so as to remove its attendant danger and other well-known disadvantages.

The space occupied by the boiler in a steamship, together with the large amount of room necessary for fuel, is the most perplexing problem that presents itself in the construction of a serviceable and economical cargo carrier. Attempts have been made to overcome this objectionable feature by placing the boilers on the upper deck of the ship, which is not so valuable for cargo space; but the fact remains that the boilers are still on board, adding at least their weight and detracting just so much from the general efficiency of the vessel.

In spite of the fact that the internal combustion engine overcomes this difficulty and gives a tremendous advantage in cargo-carrying capacity, steam-driven vessels have been clung to with a tenacity equaled only by our forefathers in their unwillingness to discard the sailing ship and adopt the steamer. So strong was their distrust of the steam engine that it is only within the last fifteen years that owners of steamships were able to overcome their fears that the steam engine might break down and dependence have to be placed on sails, as all ships up to that time were provided with considerable sail area.

There are, however, other and perhaps more weighty reasons which prevent the ship owner from adopting the internal combustion engine. Almost every port is provided with facilities for repairing the boilers and engines of the ordinary steamship; and engineers skilled in the operation of a steam engine are always available. On the other hand, facilities for ships whose motive power is the fuel-oil engine are not even now available.

Despite these disadvantages, however, the internal combustion engine is rapidly being adopted by ship owners, and any reliable record of performance is at once a source of interest.

During the past two and one-half years 16 vessels on the Pacific Coast have been equipped with the Bolinder crude-oil engine, manufactured by J. C. Bolinder, of Sweden. Ten of these are so-called auxiliary ships in which the sail power predominates. All of them are engaged in overseas trade, visiting ports where fuel is either not available or only at prohibitive prices. Fuel tankage had therefore to be provided, of sufficient capacity to supply the engine, when running at full speed, for a voyage outward and homeward of nearly 17,000 miles.

These ships vary in size from 1,500 to 3,500 deadweight tons, and the size of the engines with which they are equipped ranges from 320 to 600 horsepower. These engines are of the direct-reversible type. They have no camshafts or intricate gearing; a small compressor driven off the forward end of the crankshaft supplies air for vaporizing the fuel on entering the cylinder, and the reversal of the engine is affected by preignition.

The first large auxiliary ship equipped was the *City of Portland*, one of the three sister ships built and owned by the McCormick Steamship Company, of San Francisco. These vessels are approximately of 3,500 deadweight tonnage and are equipped with twin engines of 320 brake horsepower each. The engines have often run continuously for 45 days. The average speed maintained was 6.8 knots, but when the engines were allowed to develop their full power the speed averaged 7.5 knots. The sails were of practically no use on any of these voyages, and these vessels would more properly be designated as low-powered motorships.

The daily fuel consumption averaged 23 barrels of oil of 24 degrees Beaume gravity, and for a voyage covering 17,000 miles, 1,997 barrels of fuel oil were used.

The motorships that have attracted the greatest attention, however, are the full-powered vessels, as these afford the best opportunity of comparison with steamships. Four such motorships (twin-screw) have lately been added to the fleet of W. R. Grace & Company. They are excellent examples of the possibilities of moderate-sized ships equipped with fuel-oil engines. These ships, all of the same design, are the *Santa Elena, Santa Isabel, Santa*

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Cristina and *Santa Flavia*, and their dimensions are as follows: Length, 235 feet; breadth, 42 feet; depth, 29 feet; cargo capacity, about 2,000 tons on 18-foot 6-inch draft. The propelling machinery of each ship consists of two 320-brake-horsepower Bolinder engines. The main fuel supply is carried in steel tanks having a total capacity of 1,770 barrels, sufficient for nearly 75-days' running, and the extensive radius over which these vessels are able to travel without refueling gives them an immense advantage over the ordinary steamer. The auxiliary machinery consists of one 15-brake-horsepower Bolinder engine direct-connected to a 10-kilowatt generator and one rotary pump of 2,500 gallons capacity; also one 8-brake-horsepower Bolinder engine connected to a 5-kilowatt generator and rotary compressor. These ships carry a refrigerating plant consisting of a 1-ton Brunswick motor-driven ice machine, and each has about 600 cubic feet of refrigerating space. All of these vessels have completed voyages to New York, via Valparaiso, calling at other South American ports and the Panama Canal—a distance of over 14,000 miles, at an average speed of 180 nautical miles per day.

The engine troubles that developed have been chiefly cracked cylinder heads and broken compressor shafts. It was noted that the fracturing of the cylinder heads always occurred while maneuvering the engine in entering or leaving port, and never at sea. This, it was found, was caused by the overheating of the head when the engine stopped, as the circulating pump of the water-cooling system was driven from the main crankshaft. The sudden cooling and contraction which thus took place when the engine was started again has been entirely eliminated by devising means to keep a constant circulation of water through the cylinder heads even while the engine is at rest.

The breaking of the compressor shaft which occurred in the first three installations was due to a mistake in design which was quickly and easily rectified, and there has never been a recurrence of this trouble.

A steel motorship of 3,500 tons carries on a direct voyage of 8,000 to 10,000 miles nearly as much revenue-producing cargo as a steel steamer of 5,000 tons of the same speed, as the following table clearly shows:

	Motorship	Steamer
Deadweight tonnage	3,500	5,000
Fuel oil for 45 days at 5 tons per day, tons	225	....
Coal for 45 days at 25 tons per day, tons	....	1,125
Water for boiler, tons	....	100
Net paying cargo, tons (deadweight tonnage minus fuel and water)	3,275	3,875

It is not intended, however, to advocate the internal combustion engine for passenger ships, or for vessels carrying cargoes which must be transported within the shortest possible time, since in these cases the necessity for speed relegates the question of economy to a place of secondary importance.

Merchant ships and steamers, on the other hand, are operated solely for profit, and the hull that can carry the most cargo at the lowest cost is obviously the best.

In 1911 a ship propelled by a new type of engine entered our port after making a most successful voyage from Copenhagen, Denmark. This vessel, the motorship *Siam*, was owned by the East Asiatic Company and equipped with a type of engine known in Europe as the Diesel engine. Vessels propelled by this new type of engine repeatedly visited our coast and soon were making the trip to the Pacific Coast and thence to the Orient and back in a perfectly satisfactory and efficient manner.

In 1916, when ships were greatly needed to carry our products to Europe and were being built as rapidly as possible, the great problem of obtaining machinery presented itself. Engine manufacturers were building steam engines and boilers for large steel ships and could give no time to the building of engines for smaller craft. The average ship owner was therefore glad to get whatever he could.

When the wooden sailing vessel was decided upon to meet the great emergency, the so-called semi-Diesel type of engine was adopted as an auxiliary. Subsequently, however, it was used as a full-powered propelling unit, and thus a practice new to the shipping men of the Pacific Coast and untried by the manufacturers came into vogue. Since this proposition at once had associated with it the successful practice of the Europeans, the semi-Diesel gained great popularity.

A good many types of American-built Diesel engines have been installed and tried out. Marine engineers have had their opportunities to prove their skill in operating them, and the time is rapidly approaching when the ship owner will see that the American-built internal combustion engine occupies a front-rank position as a prime mover in ship propulsion.

Performance of the Libby Maine

BY GEORGE A. DOW

A Diesel engine installation watched with unusual interest on the Pacific Coast is that on the *Libby Maine*. This vessel is a 2,000-ton wooden ship of very rugged construction, and built especially for severe arctic service. She is 240 feet long, 43 feet beam, 24 feet molded depth, has a mean draft of 22 feet 8 inches, and is equipped with two 424-indicated-horsepower Dow full-Diesel-type oil engines. These are direct reversible and are connected through Falk reduction gears and Nutall flexible couplings. Each unit is tied to an engine bedding designed to give the maximum stiffness and greatest security against deflection. Heavy timbering securely bolted to the ship's frames runs in single lengths the entire length of the engine unit. The Nutall flexible coupling is placed between the main engine and reduction gear to relieve any possible strains between these units, as well as to act as a float. The reduction gear and thrust block are bolted to a single heavy cast iron sub-base. By the use of the reduction gear the most efficient engine speed of 250 revolutions per minute and the most efficient propeller speed for this size of ship, 100 revolutions per minute, are obtained.

The engines installed in the *Libby Maine* are of the six-cylinder open A-frame type of construction. Six cylinders were used in order to give maximum flexibility and positive starting positions, and the A-frame design was adhered to because it afforded the greatest accessibility to the bearings and pins. Marine engineers are anxious to know where their pins and bearings stand and feel more secure when they are able to "feel" parts subject to heating.

The cylinders are separate castings; cylinder heads are of standard box construction, and pistons are of the long trunk type. The crankshaft is in two sections, the forward and after section being interchangeable. The lubricating system is controlled by drip oilers, the oil being measured into individual positively timed oil pumps attached to each A-frame. One plunger of this pump supplies the piston lubrication and the other the piston pin. The main bearings are lubricated by ring oilers and the crankpin by centrifugal oil rings.

The operation of the entire engine is controlled by three levers centralized at one station. A noved feature of this installation is that one man is able to control both engines from one platform. Even in the treacherous waters of the Bering Sea this control was absolutely responsive to the captain's wish.

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Two levers are used to govern the action of the engine, while the reversing mechanism is manipulated by the third lever. Reversing is accomplished by the single movement of a vertical sliding cam, actuated by an oil-compensated air piston, which automatically lifts the cam rollers clear of all the cams, then slides the camshaft to the desired position and finally returns the cam rollers to the cams, thereby giving the proper timing of the valves for the new direction of rotation.

Air pressure is then applied to the pistons of the engine through the air-starting valves by a single movement of the control lever until momentum is acquired, when another single movement of the same control lever automatically cuts off the air pressure and admits the fuel oil to the cylinders. The entire mechanism is thoroughly interlocked to guard against any false move on the part of the operator. Automatic locking devices block the execution of any movement not made in the proper sequence. The speed of reversal is controlled by the pressure of the air applied to the air piston of the reversing cylinder and the regulation of the velocity of oil displacement from one side of the piston to the other.

In order to obtain flexibility of operation, economic use of starting air, and added security against a shutdown of the entire unit, two control levers are provided, one lever for each set of three cylinders.

The general characteristics of the engine are: Indicated horsepower, 425; bore, 12 inches; stroke, 18 inches; crankshaft diameter, 7½ inches; speed, 250 revolutions per minute; floor space, 20 feet by 5 feet 1 inch; height above center of crankshaft, 8 feet 10 inches; approximate net weight, 125,000 pounds.

An ideal trip from Seattle to Honolulu and return to San Francisco was experienced and a record in fuel economy made. Extracts from the official log indicate the following:

Fuel-oil consumption, barrels	259.5
Total distance, miles	2,440
Time of voyage	14 days, 18 hours, 15 minutes
Average economy, gallons per nautical mile	4.46
Average speed, knots	7

From San Francisco to Seattle very heavy weather was encountered. The chief engineer reported that the screw was out of the water half of the time, but no racing occurred at any time, due to the perfect action of the governors.

The engines of the *Libby Maine* are an example of approved European practice adapted to the needs of the Pacific Coast and stand as a milestone of progress in the use of the internal combustion engine as applied to marine propulsion.

Tests of Merchant-Ship-Type Diesel Engines

THE official trials of two 1,200-indicated-horsepower (750 brake horsepower) Diesel engines built by J. Samuel White & Company for the British Admiralty, were recently carried out in accordance with the special requirements of the British naval authorities and in the presence of their representatives. The engines are direct-reversible, two-cycle, single-acting, stepped-piston type, six-cylinder, 14½-inch bore by 24-inch stroke, and have a weight complete of 70¼ long tons.

The trials of the first engine consisted of 96 hours of uninterrupted running at the full load of 750 brake horsepower at a speed of about 200 revolutions per minute. During the whole trial the engine ran satisfactorily without any stoppage and without any sign of overheating either in the cooling system or working parts. The exhaust was quite invisible and very little soot was observed after the completion of the trial. The temperatures at the end of the trial were practically the same as those attained at the end of the first hour. The circulating water was passed through the engine by steam pumps, the quantity per brake horsepower being approximately 11.2 gallons. Additional maneuvering trials were carried out with the port engine consisting of astern running, time taken to pump up the starting reservoirs, slow-speed running and the drop in pressure of the starting air after each start.

Table 1 is representative of the results obtained in the 96-hour trial of the starboard engine, while Table 2 gives data on lubrication and also the heat balance of the engine.

TABLE 1.—DATA ON 96-HOUR TRIAL OF STARBOARD ENGINE

Mean brake horsepower	751.8
Mean revolutions per minute	190.5
Mean indicated horsepower	1,215.6
Mechanical efficiency, percent	61.84
Total revolutions for 96 hours	1,097,307
Total pounds of fuel oil used during 96 hours	35,205
Fuel per brake horsepower per hour, pound	0.487
Total lubricating and cooling oil used for 96 hours, pounds	887.7
Mean lubricating and cooling oil per brake horsepower per hour, pound	0.0123
Mean temperature of cooling water, inlet, degrees F.	61.5
Mean temperature of cooling water, outlet, degrees F.	99.5
Mean temperature of piston oil cooling, inlet, degrees F.	90
Mean temperature of piston oil cooling, outlet, degrees F.	125
Atmospheric temperature of test shop, degrees F.	61.5
Injection air pressure (mean), pounds per square inch	1,000
Scavenge air pressure (mean), pounds per square inch	7
Air Compressors:	
I.P. air cooler pressure (mean), pounds per square inch	127
L.P. air cooler pressure (mean), pounds per square inch	27
Circulating cooling water pressure (mean), pounds per square inch	5
Piston cooling and lubricating oil pressure (mean), pounds per square inch	61.56
Compressor suction open, percent of total	5.35
Mean indicated pressure of No. 1 cylinder, pounds per square inch	110
Mean indicated pressure of No. 2 cylinder, pounds per square inch	106.7
Mean indicated pressure of No. 3 cylinder, pounds per square inch	108.4
Mean indicated pressure of No. 4 cylinder, pounds per square inch	103.4
Mean indicated pressure of No. 5 cylinder, pounds per square inch	117.0
Mean indicated pressure of No. 6 cylinder, pounds per square inch	102.5
Blast air used per brake horsepower = 0.22 cubic foot.	

TABLE 2.—DATA ON LUBRICATION—HEAT BALANCE OF ENGINE

	Pounds	Ounce
Oil for power and scavenge pistons and L. P. compressor pistons	80	0
Oil for crankshaft and valve gearing	112	0
Oil for piston cooling and bearing lubrication	693	0
Total	885	0

(i. e., 0.22 pound per hour or 0.0123 pound per brake horsepower per hour.

HEAT BALANCE

Calorific value of fuel, British thermal units per pound	19,510
Consumption per brake horsepowwer per hour, pound	0.487
Consumption per indicated horsepower per hour, pound	0.303
Brake horsepower = 751.8 / Indicated horsepower = 1,215.6 } Mechanical efficiency, percent.	61.84

$$1 \text{ brake horsepower-hour} = \frac{33{,}000 \times 60}{778} = 2{,}550 \text{ British thermal units.}$$

1 brake horsepower requires 1.62 i.hp., therefore frictional

$$\text{Heat per brake horsepower} = \frac{0.627 \times 33{,}000}{778} \times 60 = 1{,}578 \text{ B.t.u.}$$

Heat taken in per brake horsepower per hour = 19,510 × 0.487 = 9,500 British thermal units.

$$\text{I.hp. heat units per b.hp.} = \frac{1.62 \times 33{,}000}{778} \times 60 = 4{,}120 \text{ B.t.u.}$$

	B.t.u.	Percent	
Heat converted into work on brake	2,550	26.9	43.5 percent
Heat lost in engine friction	1,578	16.6	
Heat converted into indicated work	4,120	43.5	
Heat lost in cooling water	2,480	26.1	100 percent
Heat lost in exhaust gases	2,900	30.4	
Heat taken in per b.hp. per hour	9,500	100.0	

Thermal efficiency of engine = 26.0 percent.

GERMANY'S MERCHANT FLEET.—According to information recently published, Germany now has about 2,000,000 metric tons of merchant shipping. Before the war her mercantile fleet amounted to 5,134,720 tons. Part of this was destroyed and the Allies confiscated 2,500,000 tons. The annual output of German shipyards before the war was about 300,000 metric tons.

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Sediment in Marine Boilers

Dangers Arising from This Source—Three Instances Where Sediment May Cause Trouble

BY W. R. AUSTIN

ENGINEERS in charge of multitubular boilers will agree that sediment in such boilers is most objectionable, and anyone called to survey them looks with suspicion when he sees it present in abnormal quantity on its removal from the boilers. It not infrequently happens that furnaces become distorted without the cause or the occasion being known, and observations lead to the belief that not a few accidents of this kind are attributable to the presence of sediment. As inquiries have revealed the fact that many watch-keeping engineers are but imperfectly aware of the dangers arising from its presence in the boilers, these lines are written to point out where the risk of accident generally arises.

If a vessel's boilers were always filled by hose from the shore the quantity of sediment found at the time of cleaning would be very much less. It is, however, not always possible to obtain such water, owing to the absence of facilities, while occasionally one hears of an objection on account of the expense. "Needs must when th de'il drives." The ship must sail, so the engineer is obliged to fill his boilers from the dock or river in which his ship is then lying.

Danger of Using River Water in Boilers

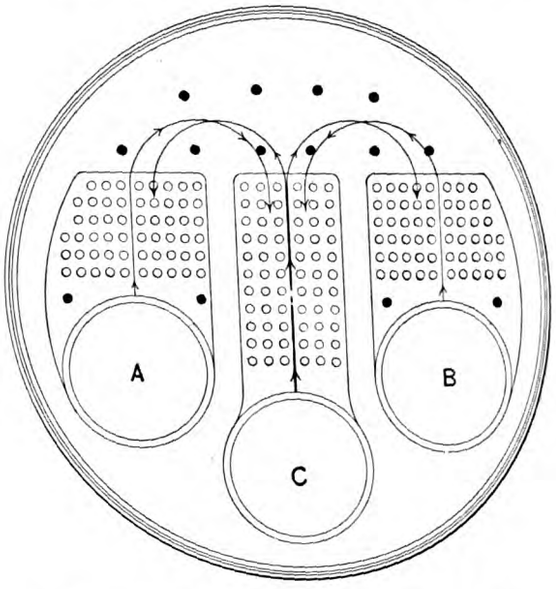
At such a time the water may appear quite clear as viewed from the deck, but appearances are deceptive. As an example, some double-bottom tanks were filled with water from the St. Lawrence River as the ship was proceeding to sea. The water appeared to be clear, yet when the tanks were opened on this side several inches of silt were found on the tank bottoms. It must have come from the river, as when previously filled the tanks had contained sea water.

Blow-off cocks are placed so low down on the ship's bilge that in many docks they are in the immediate vicinity of the mud of the dock bottom, and boilers filled in this way always get with the water a certain amount of sediment. The engineer may have used every means in cleaning the boilers to insure safety in working, but by filling them as indicated he nullifies to a great extent all his care, and admits a most insidious enemy. Once in the boilers sediment becomes a source of danger while they remain under steam. It settles down over the surface of the boiler bottom and its removal by blowing off from the bottom is not very effective, only that portion being ejected which lies within the stream lines of the flowing water close to the mouth of the blow-off pipe.

Precautions in Raising Steam

The first occasion I would mention where risk arises from the presence of sediment is in the act of raising steam. In this operation time is essential. The danger from racking strains caused by unequal expansion is so generally recognized that very few new boilers are now intsalled which have not the means of circulating the water within when raising steam. The danger to the shell is one which looms largely in the eye of the engineer, and ofttimes, it is feared, to the exclusion of another which he has overlooked. He circulates to save the boiler shell from undue strain, but in doing so brings into existence conditions which are detrimental to the furnaces. The movements due to the circulation of the water within the boiler disturb the sediment. It is thrown into circulation and flows with the water currents, whose course is liable to change with any local change of temperature. It thus becomes a menace owing to the variable temperature of the furnaces at such a time.

A specific instance of this is shown by the practice of many engineers who, when raising steam, light up the lower furnaces of a set of boilers before the wing furnaces, by this course avoiding as far as it is possible any inequality of temperature in the structure of the boiler



Sketch Showing the Flow of the Water Currents in Three-Furnace Boiler

shell. If the center furnace only is lighted when the circulation of the water begins, the water rises by convection from the furnace *C*, as shown by the full lines on the sketch, and returns to the lower parts of the boiler via the wing furnaces. The comparatively cool surfaces of the nests of tubes in each of these furnaces assist in smoothing the path of least resistance for the falling currents of water. The sediment is carried by the water, and a part of it falling between the tubes is deposited on the wing furnace crowns *A* and *B*. It lies there, and when these furnaces are lighted up and generate heat, all the elements necessary to produce collapse of the crown plates are present.

Collapse of Furnaces

In some cases a furnace so injured may remain unnoticed until it is subsequently examined. Then, on a search being made no trace of the cause of collapse can be found, as the sediment was thrown off when the plate became distorted. To prevent injury in these circumstances, uniformity of temperature in each furnace is required, and it is suggested that the circulation of the

* Paper read before the Institute of Marine Engineers, London.

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naces are lighted and uniformly burning, as thereby the risk of sediment settling on the furnace crown plates would be minimized.

The next occasion on which sediment becomes a menace arises after the ship has put to sea. If rough weather be then experienced, those who at such a time have blown through a gage glass must have noticed that the water after blowing through is much discolored. It resembles in many instances coffee "grounds." This is an indication of the state of the water in the boiler. The rolling of the ship has put the sediment from the bottom of the boiler into circulation, and its presence should be a warning to those in charge. Danger is not likely to arise while all the furnaces are uniformly generating steam, but when the time of cleaning fires comes round then care should be exercised.

CLEANING THE FIRES

Suppose that a center fire is to be cleaned. The operation is a warm one and firemen delight in having the fire burned well down to the bars. If such a one has his way when the gage glass indicates the presence of sediment, then the furnace crown, always at such a time comparatively cool, becomes a dangerous cooling surface. Hitherto the water and steam had been rising from the crown plate *C*, now its course is reversed, as shown by the dotted lines on the sketch. The wing furnaces *A* and *B* are generating steam rapidly, and the water currents rise from them and then fall with corresponding speed on the furnace crown plate *C*, bringing with them in their descent the sediment in circulation.

The water currents with their burden of sediment always come down heavily over a furnace being cleaned if it has ceased to generate steam, and if the time taken in cleaning a fire is unduly prolonged the accumulation of sediment which settles on the crown plate may easily be such that on the fire becoming thoroughly alight overheating of the plate will take place.

When viewed from this standpoint the operation of cleaning a fire at sea is a most important one and should have close attention from those in charge. It should at the moment of cleaning be kept so bright and alive that it will generate steam, otherwise a critical situation is produced.

It will be evident that these remarks apply to all boilers of the multitubular type no matter what kind of fuel is used to generate steam; the course of the water currents within the boiler being determined by the temperature at which any one or any combination of the furnaces is worked.

In the case of boilers using oil fuel, the oil is injected to the furnace through a burner or burners fitted to the furnace door. Where a single burner is used and this becomes choked or requires renewal the generation of steam in that particular furnace is temporarily stopped. The conditions then produced are in every way similar to those which obtain when cleaning a coal fire which has been burned down too low. The active heating surfaces become cooling surfaces, producing within the boiler an alteration in the direction of the water currents; sediment when showing will fall on the crown plate while the burner is being overhauled with every prospect of damage to the crown plate when it is again lighted and commences to generate heat.

The engineer in the stokehold to save time and suit the steam production to the requirements of the engines frequently shuts off one or more burners to prevent the steam from blowing off. This method of regulating the steam supply, in view of what has been said, is a most reprehensible one and should be strictly prohibited. A uniform heat should be maintained in each furnace by regulating the supply of oil fuel from each burner as may be required for the lessened need of the engines. This course is absolutely essential where single burners are fitted. In cases where twin burners are fitted to each furnace then one of these may be shut off on all furnaces in a case of urgency; but the better course is to regulate the valves which control the fuel supply to the burners. By doing so uniformity of steam production in each furnace is maintained. Evaporation will be reduced, and the risk avoided which is always attendant on shutting off the entire oil fuel supply from any individual furnace.

SEDIMENT CAUSES TROUBLE WHEN FIRES ARE BANKED

A third instance where sediment may give trouble occurs when a vessel after rough weather arrives at an anchorage and the boiler fires are banked. The rolling of the ship has ceased, but the sediment is still in suspension in the water. If all the stop valves are then closed the tendency is to stop the circulation and check the rise of steam from the heating surfaces. With banked fires the furnace temperature has fallen considerably, the upward movements of the steam grow more sluggish, and one can conceive a point being reached when steam may be generated on a furnace crown plate and remain there because of the insufficiency of heat necessary to throw it off, backed by the lack of movement in the water. In such circumstances the sediment in suspension falls on the crown plate and becomes a menace. Instances have occurred where loud reports were heard in boilers lying under banked fires, and after the report there was heard gurgling up to the steam space a considerable volume of steam.

As a means of avoiding the risk of accident while lying under banked fires, steam should be used for a considerable time after banking has taken place. By so doing steam generated is drawn to the steam space and the water is kept in circulation until such time as the sediment has settled on the boiler bottom. Fires should always be banked at the front. If banked at the back a large part of the surface of the furnace crown plate is exposed to the cold air, and thereby downward currents are induced in the water within the boilers which may lead to a deposit of sediment on the crown plate.

RECOMMENDATION

In new vessels the following suggestions if adopted would eliminate the risk arising from the presence of sediment.

The blow-off pipe should only be used for blowing off and not for filling the boilers. This can be done by fitting a non-return valve on the blow-off pipe, permitting the water to be ejected from the boiler, but preventing its admission through this pipe.

Water for feeding or filling the boilers in port or when the water is muddy should be filtered. This can be attained by a filter (with a locked by-pass for use at sea) being fitted between the donkey pump sea-cock and its suction valve chest. If more than one pump can feed the boilers, each should draw from a tee piece on the bottom of the filter.

From the boiler circulating valve on the donkey pump suction chest the circulating pipe should be connected to the blow-off pipe between the non-return valve above mentioned and the blow-off valve on the boiler. Through this pipe the boilers can be filled by running up from the sea *via* the filter, or the water in them can be circulated when raising steam as may be desired.

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Investigation Into Bulkhead Stiffeners—II

Second Class of Bulkheads, Forming Boundaries of Trimming Tanks, Peak Tanks or Deep Ballast Tanks

BY A SPECIAL CORRESPONDENT

We will now consider the second class of bulkheads—those forming boundaries of trimming tanks, peak tanks or deep ballast tanks. These we have noted are subject to stress at frequent intervals and must be designed to carry their load with a reasonable factor of safety. The scantlings are determined in the same way as for the other bulkheads, but with a head equal to the greatest head to which the tank will be subjected. To get a complete comparison of results, we will also obtain the stresses in this bulkhead when subjected to the same head as considered for the second type of bulkhead, i. e., maximum head that can be obtained with vessel still afloat. In this type of bulkheads, the stiffeners must be clipped or bracketed. Below we will consider the clipped type only:

From the tables we find that it is necessary to use a 9-inch by 3½-inch by .45-inch bulb angle.

The above angle has the following characteristics:

Area of section	6.41 square inches.
Section modulus	13.50-inch units.
Moment of inertia	66.10-inch units.
Distance of neutral axis to bulb	4.90 inches.
Distance of neutral axis to heel	4.10 inches.
Weight per foot run	21.8 pounds.

The mean plating thickness will be about .38 inch. We will assume that the width of the functional plating is thirty times the thickness.

This then gives us a section modulus as figured below:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	4.33	9.19	39.79
Stiffener	6.41	4.90	31.41
Sum	10.74	6.63	71.20

$$I \text{ of plate} = 1/12\ Ad^2 = \frac{4.33 \times .38 \times .38}{12} = .05196.$$

$$I_o \text{ of plate} = I + Ad^2 = .05196 + 4.33\ (9.19 - 6.63)^2 = .052 + 28.38 = 28.43\text{-inch units.}$$

$$I \text{ of angle} = 66.10.$$

$$I_o \text{ of angle} = 66.10 + 6.41\ \ (6.63 - 4.90)^2 = 66.10 + 19.19 = 85.29\text{-inch units.}$$

$$\text{Total } I_o = 28.43 + 85.29 = 113.72.$$

$$\text{Then section modulus} = \frac{113.72}{6.63} = 17.15.$$

The required number and size of rivets in end clips is shown in Fig. 5. The polar moment of inertia of this connection is

$$I_p = Ay^2 = .442\ (½ \times 1⅞ \times 2 + 2 \times 2\ 13/16) = .442\ (1.875 + 5.625) = 3.359\text{-inch units.}$$

Then the stress carried by these end connections being limited to 15,000 pounds per square inch, we get the following permissible bending moment:

$$M = \frac{fI}{y} = \frac{15{,}000 \times 3.359}{2.813} = 17{,}911\text{-inch pounds.}$$

This allowable bending moment is only a very small proportion of that at the ends, if these were considered fixed, and in view of this, as before, we can say that the maximum bending moment will be at about 52 percent of the length from the upper end and is found as follows:

The bending moment, if the ends were free, would be:

$M = .126\ Pl$, where $l = 12$ feet, and

$$P = Wshl + \frac{wsl^2}{2}.$$

$$P = \underset{\text{pounds.}}{64 \times 2.5 \times 6 \times 12} + \frac{64 \times 2.5 \times 144}{2} = 23{,}040$$

$$M = .126 \times 23{,}040 \times 12 = 34{,}837 \text{ foot pounds.} = 418{,}044\text{-inch pounds.}$$

The actual bending moment, however, is 418,044 — 17,911 = 400,133 inch pounds.

The rules require that the stiffeners be placed upon the water side of the bulkhead. Then in stiffener

$$f_c = \frac{M}{S} = \frac{400{,}133}{17.15} = 23{,}332 \text{ pounds per square inch.}$$

In plating

$$f_t = \frac{My}{I} = \frac{400.133 \times 2.56}{113.72} = 8{,}996 \text{ pounds per square inch.}$$

These stresses are moderate and are not much above what is considered conservative practice. They are below the elastic limit of the material, and only small deflection and sets will be found on test. In warship construction it is usual to limit the stress in bulkhead stiffeners to 20,000 pounds per square inch, but 22,000 pounds is permissible.

As a comparison we can now figure the stresses when this bulkhead is subjected to a head equal to that figured

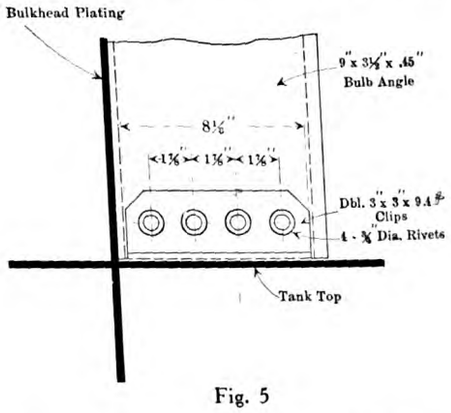

Fig. 5

for the former type. If this head was the maximum possible head under service condition, our size of stiffener would be correspondingly increased, but this head is one only possible in case of accident. The following figures have an interest as a comparison to those derived in the first part of this article.

The bending moment due to this head is, as before, 470,292 inch pounds; hence, since these stiffeners are clipped, the actual moment is 470,292 — 17,911 = 452,381 inch pounds. Then in stiffener,

$$f_c = \frac{M}{S} = \frac{452{,}381}{17.15} = 26{,}377 \text{ pounds per square inch.}$$

and in plating,

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$$f_t = \frac{My}{I} = \frac{452{,}381 \times 2.56}{113.72} = 10{,}114 \text{ pounds per square inch.}$$

These stresses also are considered moderate in comparison to those found previously for clipped and free stiffeners.

As before, let the strength of the end connections be neglected and the stress found as if this stiffener were only freely supported; then under design conditions,

$$f = \frac{418{,}044}{17.15} = 24{,}376 \text{ pounds per square inch.}$$

This stress is still moderate and shows that the bulkhead will be safe, even if the clips do not hold the ends of stiffeners rigid.

However, if the maximum head is considered for this condition, the stress is increased to

$$f = \frac{470{,}292}{17.15} = 27{,}428 \text{ pounds per square inch.}$$

Another stress of interest is when the functional plating is neglected. Then under designed conditions, considering clips,

$$f = \frac{400{,}133}{13.5} = 29{,}639 \text{ pounds per square inch,}$$

and neglecting clips,

$$f = \frac{418{,}044}{13.5} = 30{,}966 \text{ pounds per square inch.}$$

The stress in the bulkhead plating is found in the figures below. The first condition will be when the head is to the load waterline.

Pressure due to head of 12 feet = 5.28 pounds per square inch. Load on strip one inch wide is then:

$$5.28 \times l \times (30 - 3.5) = 139.9 \text{ pounds.}$$

Bending moment is:

$$M = \frac{Wl}{8} = \frac{139.9 \times (30 - 3.5)}{8} = 463.8\text{-inch pounds}$$

$$I = 1/12\, Ad^2 = \frac{.38 \times l \times .38 \times .38}{12} = .00457.$$

$$\text{Then } f = \frac{My}{I} = \frac{463.8 \times .19}{.00457} = 19{,}281.$$

While this figure is not the true stress, as explained before, it is an indication that the thickness of the plating is ample.

If the maximum head is considered, we get a pressure due to head of 13.5 feet = 5.94 pounds per square inch. Then the load will be:

$$5.94 \times l \times (30 - 3.5) = 157.4 \text{ pounds.}$$

The bending moment is:

$$M = \frac{Wl}{8} = \frac{157.4 \times (30 - 3.5)}{8} = 521.4\text{-inch pounds}$$

$$\text{Then } f = \frac{My}{I} = \frac{521.4 \times .19}{.00457} = 21{,}678 \text{ pounds per square inch.}$$

The final figures to obtain are the shear stresses. As before, let us take the shear at two feet above the bottom of the bulkhead. The shear at this point is for the designed head.

$$F = \frac{Wshl}{2} + \frac{2\,Wsl^2}{6}$$

$$= \frac{64 \times 2.5 \times 6 \times 10}{2} + \frac{64 \times 2.5 \times 100 \times 2}{6}$$

$$= 6{,}000 + 5{,}333 = 11{,}333 \text{ pounds.}$$

$$q = \frac{F}{I}\, my,$$

where the terms have the same meaning as previously indicated. Then

$$q = \frac{11{,}333}{113.72} \times 4.33 \times 2.56 = 1{,}103 \text{ pounds per inch depth.}$$

Rivets are, say, ¾-inch diameter spaced 5½ diameters center, or, say, 4⅛-inch centers.

Then the stress per rivet is 1,103 × 4½ = 4,964 pounds, and stress per square inch is

$$\frac{4{,}964}{.442} = 11{,}231 \text{ pounds.}$$

This stress is considered moderate, but requires careful workmanship in drilling and riveting up to insure that all rivets are sound and can carry this stress.

The total shear on the clip rivets is found as follows:

$$F \text{ at bottom} = \frac{64 \times 2.5 \times 6 \times 12}{2} + \frac{2 \times 64 \times 2.5 \times 144}{6}$$

$$= 5{,}760 + 7{,}680.$$

$$= 13{,}440 \text{ pounds.}$$

This shear is carried by four ¾-inch diameter rivets in double shear, or the stress in each rivet is

$$P = \frac{13{,}440}{1.8 \times 4 \times .442} = 4{,}226 \text{ pounds per square inch.}$$

Then real stress

$$P = \sqrt{P^2 + q^2} = \sqrt{4226^2 + 15{,}000^2}.$$

$$= 15{,}550 \text{ pounds per square inch.}$$

The third type of bulkhead to be considered is that of the first class when applied to passenger vessels. Here the head will again be taken to the bulkhead deck.

Considering first the unclipped stiffeners, since $l = 12$ feet and the head is 13.5 feet, we find from the table of scantlings that the nearest section obtainable in the United States to that required is an 8½-inch by 3-inch by .475-inch bulb angle.

This angle has the following characteristics:

Area of section	6.09 square inches.
Section modulus	12.00-inch units.
Moment of inertia	54.6 -inch units.
Distance of neutral axis to bulb	4.55 inches.
Distance of neutral axis to heel	3.95 inches.
Weight per foot run	20.7 pounds.

The mean thickness of plating will again be about .32 inch and the functional width will be taken at 30 *t*.

The figures for the section modulus will be as follows:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	8.66	26.59
Stiffener	6.09	4.55	27.71
Sum	9.16	5.93	54.30

$$I \text{ of plate} = 1/12\, Ad^2 = \frac{3.07 \times .32 \times .32}{12} = .0262\text{-inch units.}$$

$$I_o \text{ of plate} = .0262 + 3.07\ (8.66 - 5.93)^2 = .03 + 22.87 = 22.90\text{-inch units.}$$

$$I_o \text{ of angle} = I + Ad^2 = 54..6 + 6.09\ (5.93 - 4.55)^2 = 54.6 + 11.57 = 66.17\text{-inch units.}$$

$$\text{Total } I_o = 22.90 + 66.17 = 89.07\text{-inch units.}$$

$$\text{Then } S\, \frac{I_o}{y} = \frac{89.07}{5.93} = 15.02\text{-inch units.}$$

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The bending moment, as before, is 470,292 inch pounds, and, if pressure is on calking side,

$$f_t = \frac{470{,}292}{15.02} = 31{,}311 \text{ pounds per square inch.}$$

$$f_c = \frac{470{,}292 \times 2.89}{89.07} = 15{,}259 \text{ pounds per square inch.}$$

This maximum stress is considered too high in view of the fact that the safety of the passengers may depend upon this bulkhead.

If the functional plating is omitted, the stress will be:

$$f_t = \frac{470{,}292}{12.0} = 39{,}190 \text{ pounds per square inch.}$$

The shear stress in rivets between plating and stiffener, figured for two feet above the bottom, will be as follows:

F (as before) $= 11{,}333$ pounds.

Then $q = \frac{F}{I_o} my = \frac{11{,}333}{89.07} \times 3.07 \times 2.73 = 1{,}066$ pounds per inch depth.

Rivets ¾ inch diameter, 7 diameters pitch, or 5¼-inch centers.

The stress per rivet is $1{,}066 \times 5.25 = 5{,}597$ pounds.

Stress per square inch of rivet is $\frac{5{,}597}{.442} = 12{,}663$ pounds.

This stress is fairly moderate, but a trifle high.

The stress in plating is as found for the first type of bulkhead.

The next case to figure is that where the stiffeners are clipped, and, since l and h are the same, we find that the nearest section rolled in this country to that called for in the table of scantlings is an 8½-inch by 3-inch by .40-inch bulb angle. This angle has the following characteristics:

Area of section	5.34 square inches.
Section modulus	10.8 inch units.
Moment of inertia	48.9 -inch units.
Distance of neutral axis to bulb	4.54 inches.
Distance of neutral axis to heel	3.96 inches.
Weight per foot run	18.1 pounds.

Clips will have four ¾-inch diameter rivets.

Weight of plating same as above.

The figures for new section modulus with a width of functional plating of 30 t are as follows:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	8.66	26.59
Stiffener	5.34	4.54	24.24
Sum	8.41	6.04	50.83

I of plate as above $= .0262$-inch units.

I_o of plate $I + Ad^2 = .03 + 3.07\ (8.66 - 6.04)^2 = .03 + 21.06 = 21.09$-inch units.

I_o of angle $= I + Ad^2 = 48.90 + 5.34\ (6.04 - 4.54)^2 = 48.90 + 12.01 = 60.91$-inch units.

Then total $I_o = 21.09 + 60.91 = 82.00$ inch units,

and

$$S = \frac{I_o}{y} = \frac{82.00}{6.04} = 13.57 \text{ inch units.}$$

The polar moment of inertia of the riveting in the clips is as found before for the deep tank bulkhead and is

$I_p = 3.359$-inch units.

Then the permissible bending moment is, as before,

$$M = \frac{fI_p}{y} = 17{,}911 \text{ inch pounds.}$$

The free bending moment, as before, is 470,292 inch pounds, and the actual bending moment in this case is

$470{,}292 - 17{,}911 = 452{,}381$ inch pounds.

Then, if the pressure is on the calking side,

$$f_t = \frac{452{,}381}{13.57} = 33{,}336 \text{ pounds per square inch.}$$

$$f_c = \frac{452{,}381 \times 2.78}{82.00} = 15{,}337 \text{ pounds per square inch.}$$

It will be seen that this maximum stress is a considerable higher one than is good practice, especially in passenger vessels.

If the tieing-in effect of the clips is neglected, the maximum stress becomes:

$$f_t = \frac{470{,}292}{13.75} = 34{,}203 \text{ pounds per square inch.}$$

This shows how important it is to obtain the highest grade workmanship on the clips, because if any slip occurs the bulkhead is stressed beyond the elastic limit. Assume that the plating is poorly riveted and does not act with the stiffener; then if the clips hold firm the maximum stress will be

$$f_t = \frac{452{,}381}{10.80} = 41{,}887 \text{ pounds per square inch.}$$

This points out that the connection between the plating and stiffener should be ample. The rules specify a spacing of seven diameters, and this, it is contended, is too large. If the fixing effect of the clips is also neglected, the maximum stress becomes

$$f_t = \frac{470{,}292}{10.80} = 43{,}546 \text{ pounds per square inch.}$$

The above figure emphasizes the fact that workmanship is a very important item in keeping stresses down in a bulkhead.

The shearing stress in rivets between plating and stiffener two feet from the bottom is

F (as before) $= 11{,}333$.

Then $q = \frac{11{,}333}{82.00} \times 3.07 \times 3{,}62 = 1{,}161$ pounds per inch depth.

Then stress per rivet is $1{,}161 \times 5.25 = 6{,}095$ pounds.

Stress per square inch of rivet is $\frac{6{,}095}{.442} = 13{,}789$ pounds.

The shearing stresses in the clips at the bottom is as below:

F at bottom (as before) $= 14{,}880$ pounds.

This shear is carried by four ¾-inch diameter rivets in double shear, or the stress in each rivet is

$$P = \frac{25{,}920}{1.8 \times 4 \times .442} = 4{,}679 \text{ pounds per square inch.}$$

q, due to bending, was assumed at 15,000 pounds per square inch; then the real stress is

$$P = \sqrt{P^2 + q^2} = \sqrt{4{,}679^2 + 15{,}000^2}.$$
$$= 15{,}720 \text{ pounds per square inch.}$$

This shear stress is high, but it is in proportion to the other stresses already found. To reduce same it would be necessary to cut down the bending moment resisted by the clips and hence increase the stress in the stiffener.

The stress in the plating will be as found for the first type of bulkhead.

To sum up our figures the table on the next page has been prepared, giving the actual maximum stresses as found under the various conditions assumed above.

The conclusions that can be drawn from the above calculations are that the stresses are uniformly high and

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TABLE OF RESULTS

Type and Class	Cargo Ship Bulkheads, Unclipped	Cargo Ship Bulkheads, Clipped	Deep Tank, Clipped	Passenger Vessels, Unclipped	Passenger Vessels, Clipped
Total section modulus.	12.33	11.05	17.15	15.02	13.57
Maximum stress, design head.....	38,142	41,212	23,332	31,311	33,336
Maximum stress, maximum head.....	38,142	41,212	26,377	31,311	33,336
Maximum stress, no functional plating considered, design head	47,029	50,612	29,639	39,190	41,887
Maximum stress, no clips considered, design head.....	.....	42,560	24,376	.....	34,203
Maximum stress, no clips and no plating considered, design head	.....	53,442	30,966	.....	43,546
Shear in rivets to plating, design head	13,300	15,023	11,231	12,663	13,789
Shear in clip rivets, design head.....	.....	16,250	15,550	.....	15,720
Stress in plating, design head.....	31,707	31,707	19,281	31,707	31,707

MATERIAL NOTES

	Pounds per Square Inch
Minimum tensile strength of shapes.....	58,000
Minimum yield point of shapes.....	29,000
Maximum tensile strength of shapes.....	74,000
Maximum yield point of shapes.....	37,000
Mean tensile strength of shapes.....	66,000
Mean yield point of shapes.....	33,000

that too much credit is apparently given to the end fixing property of clips.

As regard free stiffeners, i. e., stiffeners with no end connections, we find that for ordinary bulkheads the stress as figured is beyond the mean yield point of the material—in fact, beyond the maximum yield point. This is not considered good practice because a stress of this magnitude may cause failure in the bulkhead at a critical time and consequent loss of the vessel. As seen in the above figures, even this stress can be increased when coupled with a poor quality of workmanship. In the bulkheads for passenger vessels we find a lower stress, one which is only slightly in excess of the minimum yield point of the material. Considering, however, the possible loss in life resulting from the failure of these bulkheads at a critical time even this stress is too high. The remark made above concerning workmanship applies in this.

Regarding the clipped stiffeners, it is found we have to deal with even greater stresses in this case, except in connection with the deep tank bulkheads. A stress of 43,000 pounds per square inch is considered abnormal and it is certain that, if the workmanship was not absolutely perfect, this bulkhead would fail. The stress of 33,000 pounds per square inch for the passenger vessels' bulkhead is more moderate, but is just equal to the mean yield point of the material. From the calculations for shear in the clip rivets, it is seen that this stress is more moderate than the other stresses involved and it is possible by increasing this shear to pull the stress in the stiffener down to the point where it is equal to that in the unsupported stiffener. This change in balance of the stresses would, however, make it even more necessary to obtain the most perfect workmanship possible in fitting and riveting these clips. Another method, or one to use in conjunction, would be to increase the size of the rivets in the clips to 7/8-inch diameter. By doing these two things, we could no doubt maintain the stress in the clipped and unclipped stiffener the same.

It is questioned, however, whether in practice it is possible to fit these clips with sufficient rigidity to prevent slight slips or spring when stressed. A movement no matter how slight would destroy the end fixing property of our clips, and increase again the stress in the stiffeners to beyond the yield point.

Stresses beyond or equal to the elastic limit, it must be borne in mind, should be avoided, because they are, so to speak, in "no man's land" and success or failure is difficult to foretell. In view of this, it would be excellent practice to consider even clipped stiffeners as unsupported, unless, as suggested, the riveting is increased, in fixing upon allowable stresses.

In considering the question of clips, it should be remembered that labor and not material is the controlling item in the cost of the hull and it is considered that the cost of fitting clips is rather in excess of the cost of increased material necessary to put into the stiffeners, if they are unclipped. In the present day labor and time must be reduced to a minimum, and the slight increase in weight involved in the larger stiffeners is more than counterbalanced by the saving in time and cost. This same argument applies to brackets.

Another thing brought out in the above figures is that the strip of functional plating is a most important item. The riveting between the stiffener and plating is very highly stressed in all except the deep tank and passenger ship bulkheads. The classification rules call for a pitch of these rivets of 7 diameters. The United States Navy practice is six diameters, and it is now here suggested to reduce this to five and one-half diameters for one-third the length at each end and six diameters in the middle third. This would reduce these shear stresses and insure proper re-enforcement for the stiffener itself. The effect of this functional plating, it is seen by the above figures, is greater than that of end clips.

It is further suggested that the following stresses be considered as a maximum in these two types of bulkheads, and that in each design the scantlings fixed be not accepted without an investigation into the stresses:

Cargo boat bulkhead stiffeners' maximum stress equals 30,000 pounds per square inch.

Passenger vessel bulkhead stiffeners' maximum stress equals 28,000 pounds per square inch.

Shear in each case in plating connections and clip rivets maximum equals 12,000 pounds per square inch.

In connection with the deep tank bulkheads, the stresses found appear satisfactory, the maximum stress under design head being only 23,550 pounds per square inch. The shear in the rivets is only 11,000 pounds, and this decrease in stress over that shown on the other bulkheads is because the spacing of rivets has to be reduced at the ends. The shear stress in clip rivets appears a little high. The limiting stresses in this case should be:

Deep tank bulkhead stiffeners, maximum stress 24,000 pounds per square inch.

Shear in plating connections and clip rivets, maximum 12,000 pounds per square inch.

In deep tank bulkheads the American Bureau of Shipping requires that the stiffeners be clipped or bracketed. As long as a sufficient section modulus is introduced, the author fails to see why it should not be permissible to fit stiffeners without end attachments. As before stated, it is believed this would mean a saving in labor and cost, as well as time.

A final word in connection with permissible stress in stiffeners. Navy practice is 20,000 to 22,000 pounds per square inch. In this case, as well as in deep tank bulkhead, these structures are subjected to a static test to test strength, deflection and tightness. This is a very satisfactory test on the workmanship, and it might be said about the only possible one. In the other type of bulkheads, although greater stresses are permitted, no means is available for testing the workmanship. True, they are

(*Continued on page 561.*)

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Keeping the Engine Room Log

Data Recorded in the Log—Its Use in Determining Economy of Vessel and Locating Wastes

BY W. E. DAVIS

At this time, when there is so much speculation regarding the future of the American merchant marine, the one consideration brought out in all discussions is efficiency—efficiency of production and efficiency of operation. Stress has been laid on the idea of economical machinery, not only in regard to operating cost, but also as to the space occupied by machinery and fuel. Economy of fuel means increased cargo space. In some of the standardized turbine gear drives developed for merchant ships during the war, we have plants which are compact and operate at efficiencies far above the old reciprocating engine layout.

Duty of the Chief Engineer

The original design and installation of propelling machinery may be efficient, but unless the plant is kept in this condition and attention is given to the daily performance, it is impossible to prevent needless operating losses. This is squarely up to the chief engineer. Navy regulations require that numerous logs and records be kept regarding the detailed operation of the engineering department aboard ship. Some of the same information has been required aboard ships operated by the Naval Officers' Training School and the Shipping Board.

In the past there has been a great variation in the requirements of various privately owned steamship lines. Disregarding previous practice, as a matter of routine there are certain data which are simple to record, and a daily analysis of which will give the chief engineer valuable information regarding the economy of his plant and enable him to locate waste. Just to keep machinery running and bearings cool is not enough—the whole plant must be run efficiently. In the last analysis, the prime consideration is the cruising radius for a definite cost of fuel. At a certain fixed speed the fuel expenditure per twenty-four hours, making allowances for weather conditions, should be a given amount, depending on what auxiliaries are in operation.

Navy Log Sheet

Fig. 1 shows the rough log sheet commonly used in the Navy and which, with slight variations to suit the type of ship, might be used in the merchant marine.

The first thing to do is to obtain the water rate of the various prime movers and auxiliaries in the ship when operating under normal conditions, as well as the rate of evaporation of the boilers. It is not necessary to go into exhaustive tests in order to make this analysis valuable.

The drains from the evaporators may be segregated and run to a spare tank for the period during which the amount of water is to be measured. Thus the number of gallons of water per pound of steam may be determined. The exhaust from lighting sets and other auxiliaries may be run separately to the auxiliary condenser for a period during which all other exhaust is run to the main condenser. The condensate from the auxiliary condenser is then run to a separate tank, where it may be measured in order to determine the water rate of these auxiliaries.

The main turbines will use a definite amount of steam, depending on pressure and nozzle openings. Napier's formula can be used to determine the amount of steam used by the turbine:

$$\frac{\text{Absolute pressure} \times \text{area of nozzle in inches}}{70} = \text{pounds of steam per second.}$$

The circulating pump will deliver a definite number of gallons per minute, depending on its speed.

It is thus possible to obtain a standard of what each piece of equipment should use. Also, in the case of a new ship, the manufacturer of the various machines can furnish data regarding steam consumption at various speeds and loads.

Analyzing the Log Sheet

How this information may be analyzed for use is the next point to be considered. The noon coal report comes in. It is found that a certain amount of fuel for the given speed has been used. In this instance the consumption is greater than usual. In the log there is a record of the machinery in operation during the past twenty-four hours and the conditions under which it has operated. This information, combined with the water rates which you have obtained, can be summarized as shown in the following table, assumed for a turbine gear drive cargo ship:

Unit	Hours in Operation	Nozzle Opening	Pressure, Absolute, Pounds per Square Inch	Pounds Steam per Hour	Pounds, Total
Main turbine.....	24	2.238	160	18,414	441,936
Circulating pump.	24			1,330	31,920
Condensate pump.	24			300	7,200
Air ejectors.....	24			440	10,560
Lighting set*.....	24			936	21,684
Main feed pump†.	24			500	12,000
Bilge pump	8			400	3,200
Flushing pump...	24			300	7,200
Evaporators‡	20				32,000
					567,680

* Average load, 8 kilowatts.
† Average, 30 strokes per minute.
‡ 200 gallons per hour; total, 4,000 gallons at 8 pounds steam per gallon.

The coal expenditure for the twenty-four hours has been thirty-one tons, which, with an evaporation of nine pounds water per pound of coal, would represent 624,960 pounds steam, although our total from the machinery is 567,680.

Check on Steam Consumption

Now, for a further check, it is found that the circulating pump has averaged 2,500 gallons per minute and that the temperature rise has been 17.5 degrees, which, from the formula,

$$\text{Pounds of steam per hour} = \frac{\text{degrees' rise in temperature (gallons per minute} \times 500)}{940}$$

gives us 23.165 pounds per hour, equals 555,960 pounds per twenty-four hours. This checks with the summary of machinery and would indicate that the fireroom is the place to look for the trouble.

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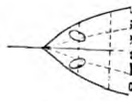

ged conditions, where distance (200 knots or more) omically determined by a number of ships, is obtain- ning (or any considerable time between land bearings nce is measured, **actual average speed per hour** and per minute per knot should be entered on Sheet A. but slight variation in speed, and steaming between ensible change in course, a distance of 226.8 knots is -screw turbine vessel in 12 hours and 36 minutes, the all screws) being 975,240. Entry on Sheet A, under ld be: **average speed, 18 knots; average revolutions ot, 23.88.**

STEAM PRESSURES.

ge variety of naval installations, it is not feasible to ead turbine-steam-pressure columns (numbered 12, sheet) as to provide for all types and combinations. ft blank, therefore, and should be headed on ship- articular type and combination installed.

ressures on this and other log sheets, the following be carefully observed: Pressure in pounds is to be s as **gauge or absolute**, as set forth below, and **absolute** understood as gauge pressure plus 15 pounds; where (pounds-inches) are installed, graduated to read above the atmosphere, and in inches (mercury) for he atmosphere, the latter is to be converted into by computing each 2 **inches equivalent to 1 pound**

m gauges, and such gauges as are connected to main or s in engine room, or elsewhere, readings recorded should

steam chest of Curtis or Zoelly turbines should be recorded d succeeding stages in *absolute*; for Parsons turbine propelling l (or steam belt) pressure should be recorded as *gauge*; suc- any stage, or turbine, when recorded, should be in *absolute*.

tted with turbines, where reciprocating machinery is installed the H. P. steam chest pressure is to be recorded as *gauge*, ures as *absolute*.

perated *auxiliary* machinery, pressures that are invariably re should be recorded as *gauge*, and those invariably below *absolute*. When, however, a change in operating conditions oduces a change in the pressure to be recorded, so that at is above and at other times below the atmosphere, *absolute* ure be recorded.

avoid drill- them built

RY INDEX AND MACHINERY HISTORY.

was also an

ndardize the system of recording work, casualties and linations, etc., naval vessels using this type of engine- revent their ake up a "machinery index," consisting of a list in prop- read to have of each and every "machinery unit," under the cogni- lineer Officer, and as outlined below, to include every to be fast for the operating condition of which he is responsible. sistent with achinery unit" is to be understood as:

one pump, one evaporator, one generator, one lathe, etc.

s of the propelling machinery, and other complicated installa- ssure cruising turbine; port main turbine; starboard astern ller, etc.; forward heating system, starboard main suction bilge pump, overboard discharge piping, etc.

compartments, such as drum rooms, wash rooms, double

ditions were trolling and

hat destroy- the destroy-

nery unit" is to be given a "machinery index" number; bers once assigned are permanent numbers. All units ations should preferably bear numbers from 1 to 100; n stations, 101 to 200; and for outside auxiliary stations, som 201 to 300 (or above). For example: Boiler No. 1 1; the forward auxiliary feed pump (installed in fire- No. 13; index No. 101 possibly would be high-pressure index No. 106, port main air pump; index No. 201, ice or complicated machinery units, the index, if desired, ubdivided as follows: Index No. 1 being assigned to particular part of this boiler may be definitely desig- combination of figures and letters, thus: **Index No. 1-a** e safety valve of Boiler No. 1; 1-b, the stop valve, etc.

placement of ight well be inch or 4.7-

y history" of each "machinery unit" should be kept, work turned typewritten quarterly on D sheets of the loose-leaf log, uilt by firms warded to the Bureau of Steam Engineering with the room log, the duplicate copy to be permanently bound esse. opy which is retained on board.

ery history" of each "machinery unit" should be a rd showing every casualty and its cause, repair, modi- n, replacement, overhaul, inspection, or examination ery unit" has undergone (whether by ship's or yard quarter. Each entry in the "machinery history" learly, but briefly, what work was done, or condition ction, etc.

Admiralty, built for for- ', Yarrow, ', have been

mbating the continuous

data (A) sheet of the log, under "Remarks," it is neces- the machinery index numbers of the "machinery units" as done, thus:

Further entries relative to such work are not required on A sheets.

At the end of each quarter the record of work is transcribed on D sheets (using both sides), as follows: First, a list of index numbers with the names and description of corresponding machinery units, this being necessary to enable the Bureau and all persons who are or who may be connected with the engineering department on board ship to identify the various machinery units. Following the list of machinery index numbers is the machinery history of each unit for the quarter: thus, beginning with No. 1 there is written the date corresponding to notation on daily data (A) sheet of the entry, i. e., the casualty, its cause, repair, overhaul, examination, etc. Succeeding entries continue the numerical and chronological record in sequence of every unit on which work was done, or which was inspected during the quarter; thus:

Index No.	**Date.*	*Remarks.*
1	1–25	Removed and replaced 28 grate bars.
	3–16	Examined water side: pitting observed around drum opening of surface blow, extending over an approximate area of 6 by 8 inches, the deepest pit being about $\frac{1}{32}$ inch; other interior parts free from pits.
13	1–26	Overhauled and repacked water piston, substituting Tuck's for flax packing originally installed.
	2–14	Removed head for examination of steam cylinder, piston, etc
101	3–2	Hoisted upper casing for examination of interior parts of turbine. Condition of rotor and blading as follows. * * *.
106	2–2	Renewed 2 bent guards and 2 receiving valves, etc.
201	3–4	Examined compression cylinder piston, and renewed leather packing.

*NOTE.—Use figures to indicate month and day; thus; 1–2, 2–14, etc. (omit year).

As heretofore pointed out, the "machinery index" when once made up for any vessel, should require no change, from quarter to quarter, except in event of replacement of a "machinery unit." Extreme care, therefore, should be exercised that the "machinery index" completely covers the machinery installation, and that identifying or important descriptive characteristics of each unit (type, make, size, etc.) are briefly noted in the index; for example:

Index No.	*Name and description of unit.*
1	No. 1 boiler; Normand type (oil-burning) fitted with 12 burners; diameter (inside) of (1) upper and (2) lower drums, 44 and 10 inches, respectively; 116 1¾-inch tubes, 120 mils in thickness, and 1,594 1¼-inch tubes, 109 mils in thickness; furnace volume, 520 cubic feet; heating surface, 5,377 square feet.
2	No. 2 boiler; same as above.
7	Forward auxiliary boiler; single-ended, Scotch type; diameter (outside) 10 feet; length (extreme) 8 feet 6 inches; 216 2½ inch tubes, 5 feet 10 inches long (156 ordinary of 109 mils thickness, and 60 stay of 203 mils thickness); grate surface, 33 square feet; heating surface, 976 square feet.
13	Forward (No. 1) auxiliary feed pump; Warren, vertical, double-acting, single; diameter of steam cylinder, 15 inches, and of water cylinder, 10 inches; stroke, 16 inches.
101	H. P. cruising turbine; diameter of rotor, 30 inches; number of expansions, three, 18 rows of blading to each; length of blades, ⅜, ½, and ¾ inches.
106	Port main air pump; Warren, vertical, twin, bucket, single-acting; one steam cylinder, 14 inches diameter; two water cylinders, 28 inches diameter, with stroke (common), of 18 inches.
109	Port (left-handed) propeller. Three-bladed, manganese bronze, cast solid; diameter, 7 feet 4 inches; mean pitch, 6 feet 8 inches; helicoidal area, 28.7 square feet.
201	Allen, dense-air, vertical, ice machine; rated cooling effect, ½ ton; diameter of cylinders: steam, 6 inches; compressor, 4¼ inches; expander, 4 inches; stroke (common), 8 inches.

The system above outlined possesses the advantage of making the engine-room log a history of the engineering department, with little or no more clerical work than involved in daily entries on A sheets; and, furthermore, repairs, casualties, examinations, etc., of every machinery unit during the quarter is thus segregated, eliminating the necessity of searching through each page of the quarter's log to ascertain information pertaining to any particular machinery unit.

A machinery index should be inserted in each quarter's log, and the index and history should immediately follow the daily data (A) sheets for the quarter and be paged accordingly. In order to obviate the necessity of typewriting, the index may be in printed form on D sheets if facilities are available on shipboard.

'stop." etc., write out in full the signal in second column, with time in first column, and resultant revolutions in third column.

boiler room. it is possible milar to the equirements. ing his plant check.

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RK DONE BY SHIP'S FORCE.

ENGINE ROOM.

FIREROOMS.

XILIARY STATIONS.

SUPPLEMENTARY LOG INSTRUCTIONS.

SPEED.

log instructions, speed to be recorded in column 2 is
ions of the propelling machinery (column 1) regardless
ws or ship's bottom, displacement, trim, weather
s, etc. When, however, opportunity offers to secure
gh the water, as when steaming in squadron, under

Firerooms—
Index Nos. 1, 13.
Engine rooms—
Index Nos. 101, 106.
Auxiliary Station—
Index No. 201.

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On the other hand, if the temperature rise had been 20 degrees, with 2,500 gallons per minute circulating water, then the steam per hour, by the above formula, would be 26,596 pounds, a total of 638,304 pounds for the twenty-four hours. This figure checks with the amount of fuel used, and would indicate that the place to look for trouble is in the engine room and not always in the boiler room.

Of course, operating conditions vary, but it is possible for each engineer to work out a schedule similar to the one outlined and to apply it to his individual requirements. He will find that the knowledge gained regarding his plant is well worth the time necessary for this daily check.

Naval Construction During the War*

Destroyers and Flotilla Leaders—Patrol Boats—Sloops and Mine Sweepers—Submarines—China Gunboats—Air Craft

BY SIR FUSTACE TENNYSON D'EYNCOURT, K. C. B.

To give a complete account of the development of the design and construction of our destroyers and flotilla leaders during the war would mean a very long paper, and I think, therefore, I must refer only to the tables and plans which I give. These vessels have gradually increased in size and power, and war requirements have continually added to the weights which they have had to carry, including considerable more fuel, heavier armament, both of guns and torpedoes, depth charges, larger bridges, and other additions. In fact, some of the ships which before the war were 900-ton vessels, now carry an additional 100 tons, which, of course, is a very heavy handicap to these vessels when expected to maintain a high speed. The introduction, however, of the geared turbine has added enormously to the efficiency of the machinery and propellers; the lower revolutions which can be introduced with the gearing enabling us to adopt much more suitable propellers, in addition to giving a greater economy of fuel.

Destroyers and Flotilla Leaders

During the war, nearly 300 destroyers and flotilla leaders, which are simply a larger form of destroyer with improved accommodation, have been added to the fleet, and the whole class of these vessels has been called upon to do continuous work in heavy weather. They have come through the ordeal with extraordinarily few breakdowns of machinery or other parts of the ship, while the duties they have been called upon to perform in combating the submarines, convoying, etc., have been most continuous and varied.

Most of the designs have been got out at the Admiralty, but certain others, including some destroyers built for foreign countries and taken over by the Admiralty, have been evolved by the builders, Messrs. Thornycroft, Yarrow, White, Fairfield, J. Brown, and Hawthorne Leslie.

Numbers of these vessels also have been built by firms who had never built a warship before, but the work turned out by them has fully met the Admiralty requirements.

The flotilla leaders, with a deep load displacement of about 2,000 tons and an armament of four 5-inch or 4.7-inch guns and with their very high speed, might well be described as fast scouts or third-class cruisers.

Patrol Boats

Patrol boats naturally follow the torpedo-boat destroyers, as they were specially designed to relieve the destroyers of some of their strenuous duties of patrolling and submarine-hunting and escort work. The conditions were that they had to be as small as possible, consistent with keeping the sea in all weathers. They had to be fast enough to run down submarines, and they had to have shallow draft and all top-hamper kept low to prevent their being seen at a distance. Economy of fuel was also an important feature, and it was desirable to have them built of mild steel rather than high tensile steel, to avoid dril-

* From a paper read before the Institution of Naval Architects. Concluded from the July issue.

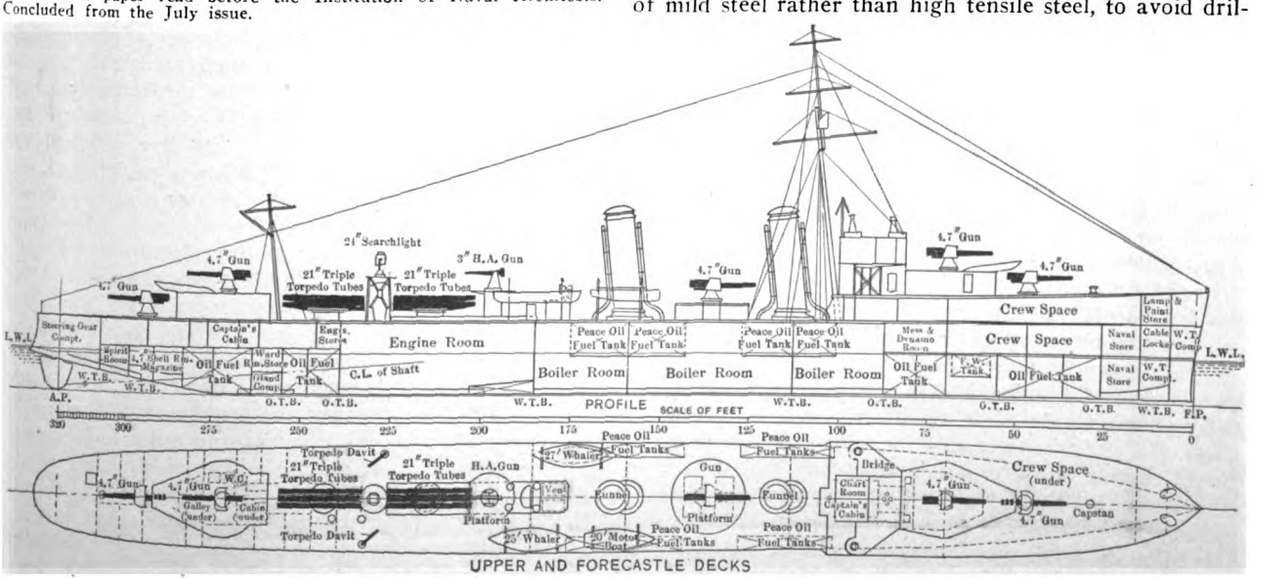

Fig. 9.—H. M. S. *Scott* Class, Flotilla Leader. Admiralty Design (1916)

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ling and special workmanship. They were provided with a special hard steel ram, with which a considerable number of enemy submarines were sunk without damaging the patrol boat. The various features were combined in a vessel of something under 600 tons, with geared turbine engines of 3,800 horsepower, giving a speed of over 22 knots. with 330 revolutions of the propellers. The boats had large rudder area and were cut up aft, so that they could turn very quickly upon the enemy—a most important feature for ramming purposes. They proved very valuable boats, and did a great deal of work against the submarines in all weathers. They were armed with only one 4-inch gun, mounted in a commanding position in the forward superstructure, one 2 pounder and two 14-inch torpedo tubes, and later it was arranged to carry depth charges.

Several of these vessels were mined, and although the damage they sustained was very severe, they kept afloat and were repaired.

We had the honor of being asked to design and provide some vessels of this type for the French government, and eight of these were built for that purpose and armed with somewhat heavier armament than our own ships. I understand that the French government was very well satisfied with the vessels.

In addition to this, at a later stage, for sweeping in shallow water, some paddle mine-sweepers were designed at the Admiralty, of which particulars are given in the table. These were 15-knot boats, with draft just under 6 feet 9 inches. They did good work, but were of course not such good sea-boats as the sloops. As there was some

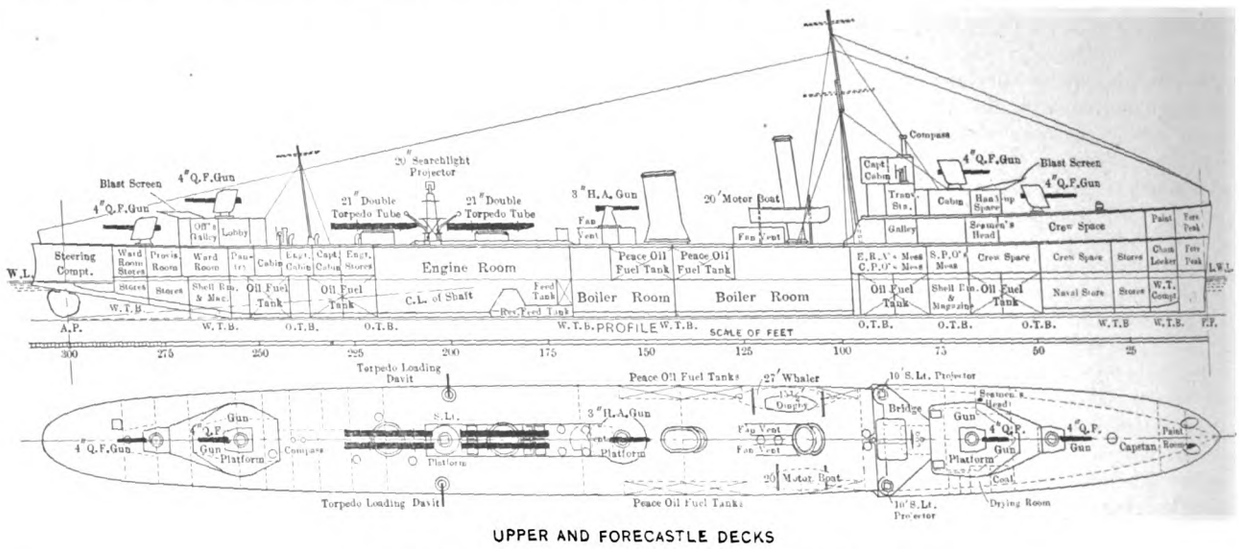

Fig. 10.—H. M. S. *Vectis*, Admiralty Design, "V" Class Destroyer

Their cost was, of course, considerably less than that of a modern destroyer.

Some of these boats were afterwards disguised to look like small mercantile craft—a device which also proved quite successful.

On the outbreak of the war it became clear that there would be a great demand for mine-sweeping vessels. A good many coasting and cross-Channel steamers were taken up for this purpose, but more were required, and it was decided in December, 1914, to build twelve single-screw ships of simple design to this end. With the view of hastening construction, it was decided to adopt mercantile practice as far as possible in both hull and machinery. The vessels, although of very fine form, were built of simple construction and under Lloyd's survey. The boilers were of ordinary Scotch type, and single-screw machinery was provided.

In the end, nearly 100 of these vessels were built, and the armament, which at first was two 12-pounders, was subsequently increased to two 4-inch or two 4.7-inch guns. A great many of these vessels were built in about six months from the order, and the first thirty-six averaged twenty-five weeks in building. They proved excellent sea boats, and were used not only for mine-sweeping, but also for submarine work, especially for convoying. At later stages some of these vessels were disguised as ordinary merchant ships. They were economical steamers and were able to attain a full speed of 17 knots, with a horsepower of about 1,800 to 2,000 in the earlier, which was increased to 2,500 in the later, vessels.

danger of mines getting under the paddles, a further design of twin-screw mine-sweepers was got out, of which particulars are also given in the table. These were vessels of about 800 tons and about 16 knots speed.

As it would make the paper rather too long, I am only giving a table of the particulars of the designs of submarines, but a very large number of these vessels have been added to the fleet during the war, and some twelve different types, some embodying very special requirements and all being improvements on their predecessors. It is interesting to note that we produced the fastest internal-combustion engined submarine in "*J*" class, which attained a speed of over 19 knots. As a still higher speed was wanted for fleet work, the "*K*" boats were designed with a surface speed of 24 knots. To arrive at this it was necessary to go to steam and special arrangements, of course, had to be made for shutting down watertight the funnels, etc. However, all these difficulties were overcome and the boats proved very successful.

It is an interesting point about these vessels also that, besides the steam turbines for full speed on the surface and the electric drive when under water, they are provided with a Diesel engine for use just before diving or immediately after breaking surface, in order to hasten the time of diving or of getting away quickly after coming up. The transmission from the Diesel engine was through the electric motors, so that these vessels had not only geared turbines for the steam drive, but they also had electric transmission with a Diesel engine and electric battery drive when under water.

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Although the Germans had the advantage of more power per cylinder in their Diesel engines, we produced faster surface boats, faster underwater boats, and more heavily-armed boats than they.

M.1 submarine, of which some account and illustrations have already appeared in the press, was a monitor submarine armed with a 12-inch gun; she was an experimental boat.

"China" Gunboats

I should not omit to mention the two classes of so-called China gunboats, designed by Messrs. Yarrow. The smaller of these vessels, 120 feet long and of about 100 tons, was constructed in this country in such a way that the parts could be sent out to Abadan, where they were assembled. and the vessels re-erected and completd under the supervision of the Admiralty officers. Some of the larger boats, 230 feet long and of 645 tons, were completed here and went out to Mesopotamia, where all of them were of the greatest service in that campaign.

It is impossible to mention all the small craft built, but most useful work was done by motor launches and many other types.

Other Auxiliary Craft and Aircraft Carriers

We were called upon at the Admiralty to design many other auxiliary craft—notably some fast fleet oilers which were able to carry 5,000 tons of oil and had a speed of 15 knots. We also designed a great number of special smaller craft for all purposes, and we had to take over and modify, sometimes very extensively, a number of merchant ships for various purposes.

Probably the most important modifications were those made to vessels taken over and converted into aircraft-carriers, including *Campania, Ark Royal, Engadine, Riviera,* etc. I have already alluded to the *Furious,* but one of the *Raleigh* class has also been converted into an aircraft-carrier, and is now named *Vindictive.* The *Argus* was originally built as a passenger mail ship of 20 knots and was taken over and converted into an aircraft-carrier with complete flush deck, the funnels being carried aft in long horizontal ducts, discharging the smoke astern. The *Eagle,* alluded to above, is also being converted into a large aircraft-carrier with a somewhat different arrangement; but it would take too long to go into any detailed account of these ships. There is no question that aircraft-carrying will gradually become more important for the fleet.

Altogether during the four years some 2,000,000 tons have been added to the Navy, at a cost probably between £250,000,000 and £300,000,000 sterling.

Reference to the navy estimates show that the aggregate sum spent during the four years before the War on new construction amounted to approximately £60,000,000.

Besides purely ship design and construction, up till the autumn of 1917, as Director of Naval Construction, I was responsible for the rigid airship designs, to which all our existing rigids have been constructed; the responsibility for this branch was in 1917 transferred to a special Airship Production Department, but officers of the Royal Corps of Naval Constructors transferred to the new department continued the work they had been doing on airships.

The Ports of Trieste and Fiume

With the Italian occupation of Trieste, it is of interest to note that this city is the largest and most important port of the Adriatic. In 1913, for instance, the total movement of navigation in the harbor of Trieste amounted to 5,480,074 tons, representing 57.3 percent of the maritime movement of all that part of the Adriatic coast which has been included in Austria-Hungary.

Fiume, after Trieste, is the most important port of the eastern Adriatic, and its traffic showed considerable development in the last few years before the war. The tonnage discharged increased from 1,681,151 tons in 1900 to 2,564,665 tons in 1912.—*Commerce Reports.*

Trials of the Freighter Diablo

ALL ships constructed for the United States Shipping Board are subjected to rigid acceptance trials arranged by the division of operations of the Board. A typical series of trials which gave good results was recently carried out on the freighter *Diablo,* the first ship built by the Pacific Coast Shipbuilding Company, of San Francisco, in their yards at Suisun Bay, Cal. First a six-hours' dock trial was held to determine that all machinery and auxiliaries were running smoothly. The ship was then made ready for a six-hours' full power run with part of her cargo. This run was made in Suisun, San Pablo and San Francisco bays. After its successful completion, the ship was put into dry dock at the Union plant of the Bethlehem Shipbuilding Corporation, where the hull was painted so that the ship would be in condition for sea immediately after her standardization trials. In order to have the normal draft necessary for these trials, and to waste no time in starting on her maiden voyage after their completion, her entire cargo for Hong Kong and Indian ports was loaded at a berth of the Pacific Mail Steamship Company, under whose flag she sails.

At the time of sailing her mean draft was 24 feet 11½ inches, gross tonnage registered at the custom house 6,103.46, and net tonnage 4,573. The deadweight cargo capacity of 9,683 tons was actually about 300 tons more than required by the specifications. Of this capacity, 240 tons consisted of water, 1,664 tons of fuel oil, 60 tons of ship stores, 90 tons of boiler water, 75 tons of dunnage, and about 7,500 tons of freight.

The average speed for the four standardization runs made between San Francisco and Point Reyes, a distance of 21.75 miles, was 11.06 knots; the average revolutions per minute of the propeller, 89.35; the fuel consumption per knot per hour at a speed of 11 knots, 0.92 barrels of oil; total consumption per hour, 10.1 barrels of oil.

The speed of 11.06 knots attained is rather exceptional for a fully laden ship of the *Diablo* type, and the fuel consumption is well within the ordinary average.

Investigation Into Bulkhead Stiffeners

(*Continued from page* 557.)

often subjected to a hose test, but this is merely local pressure applied to test the tightness, and no stresses of any magnitude are developed.

In general, it is engineering practice to design untested parts with a larger factor of safety than tested parts in order to feel sure that they will not fail in service. In our bulkheads, it is seen, we do just the opposite, and in view of our "non-engineering" procedure it would seem best to limit our stresses to the figures given above and avoid the risk of failure. A ship and its cargo or passengers is a fairly valuable article these days, or, in fact, at any time.

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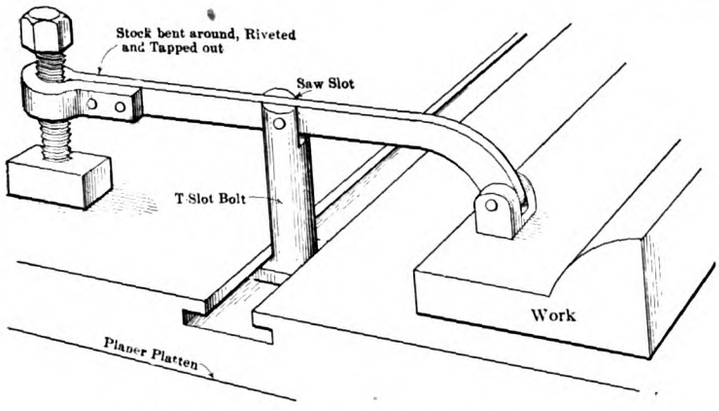
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Handy Planer Clamp

This simple type of planer clamp was evolved by a planer hand to supply a quick-acting clamp for holding special parts, of which he had a quantity to machine. He made up a set of eight of these clamps, and speeded up the



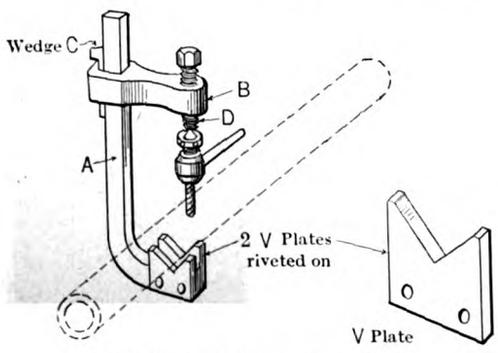
Quick-Acting Clamp for Use on Planers

work of setting up considerably. The drawing shows the clamp in detail. The bolts were ⅞-inch and the clamp arm ⅜- by 1-inch stock. The end in which the adjusting screw is used is formed by bending the stock around in a small circle, riveting the two parts and then tapping out.

MACHINIST.

Pipe Drill Post

I have recently made several sizes of the type of pipe drill post or old man shown in the sketch. I designed this



"Old Man" for Drilling Pipe

simple affair to meet the need of a light yet durable tool.

The upright *A* is of ½ by 1-inch bar with two *V*-plates, such as shown in the detail sketch, riveted to the lower curved end. The jaws are serrated to prevent slipping. The crosshead *B* is forged and the slot for the upright drilled and filed, one end being slightly tapered to take the wedge key *C*. The screw *D* is cup-pointed and case-hardened.

The rig is very easy and cheap to make. W.

Cruiser Stern on Standard G-Type British Vessels

The accompanying illustration will be of interest to readers of MARINE ENGINEERING, as it shows the "cruiser"

Cruiser Stern of the *Nowshera*

stern of the British steamship *Nowshera*, which is typical of the new standard *G*-type freighters built in Great Britain. The *Nowshera* has a length of 450 feet, a beam of 58 feet 3 inches, a molded depth of 37 feet, and a displacement of about 11,000 tons at the load waterline.

New York. T. J. SMITH.

Unique Machine Strap

Those who operate a drill press or milling machine will appreciate the novel strap that is shown herewith. With the old plain U-shape strap it is always necessary to hunt up blocking to use under the outer end of the strap, and not always can one find just the right thickness of blocking, so washers, etc., have to be hunted up. This strap, designed by a practical shop machinist, does away with that trouble, for the strap is made from steel bar stock with a slot in its center for the regular holding

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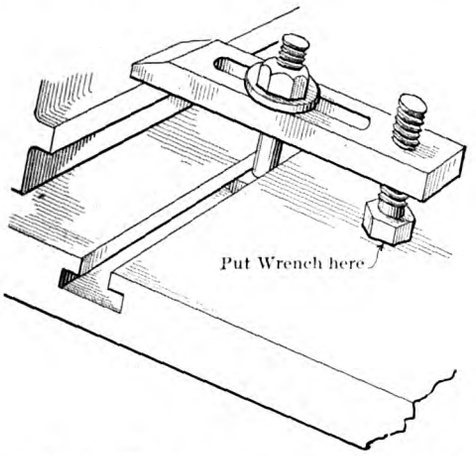
down bolt. A bolt hole is drilled and tapped in the outer end of the strap to take an adjusting bolt. In setting up



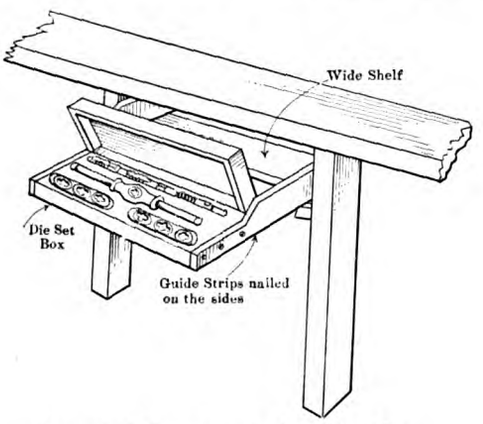
Strap for Holding Work on Drill Press or Milling Machine

work all that is required to level up the strap is to unscrew the bolt. W.

Handy Place for the Die Set

Most pipe or bolt die sets are sold in neat, compact cases to hold each part in its place. In order to get into this case, however, it must be set where it is easy to open the cover.

When a mechanic is doing a bit of work which calls for a die, he goes to the tool room and gets just the die he wants. If the tool room is like most that I have seen,



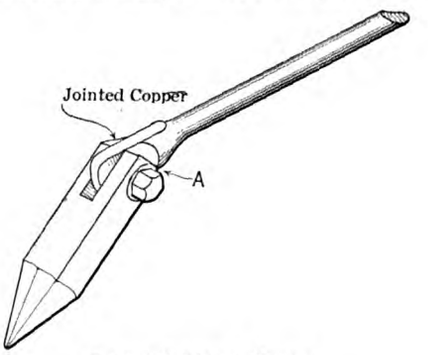
Convenient Arrangement of Die Set Case

the die set case has to be taken down off a shelf and then opened. To save time and make things convenient, I rigged up our die set cases as shown in the sketch, with guide strips on the sides so that the cases can be easily drawn out and the covers opened.

TOOL ROOM MECHANIC.

Jointed Soldering Copper

After having done work with a straight regular type of soldering copper that required me nearly to stand on my head to get at it, I hit upon the idea shown in the drawing, that of making a jointed soldering copper that could be used at any convenient angle. To make it was a simple task. The regular straight handle was cut off next to the copper and its end forged out thin and flat. The end of the copper was then slotted to take the flattened end of the handle, a hole having been drilled in it

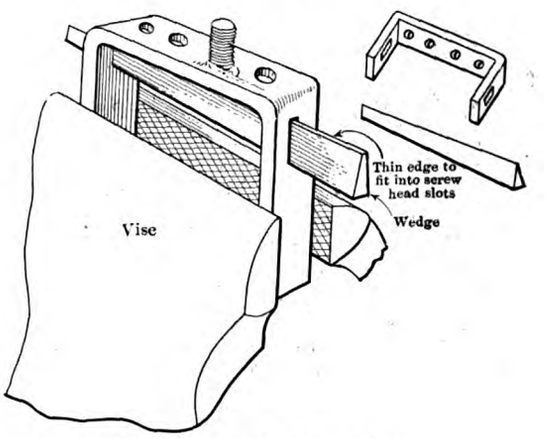


Jointed Soldering Copper

to take the clamping bolt *A*. This tool is worth many times the old straight type. W.

Screw Vise

Sometimes it is necessary to recut down the threads of screws or to hold them without injury while filing the end. The work is easily done by such a vise as shown in



Vise Clamp for Holding Screws

the sketch. This is made from a piece of thin flat stock, and a taper wedge with a thin edge that fits into the slot in the screw head, preventing it from turning. The sketch shows the tool in a way that precludes further description.

Concord, N. H. CHAS. H. WILLEY.

How the Germans Destroyed Their Own Ships

In the Panama Canal shipyards at the present time are several large German freight and passenger steamers undergoing repairs. These ships were brought from South American ports, where they had taken refuge from the British navy and had subsequently been interned.

While in port in South America the Germans had done destructive work to the machinery similar to that done by them on many of their boats in American ports at the beginning of the war, engine cylinders being cracked and broken, essential parts of machinery being thrown overboard, etc. American ingenuity has, however, found satisfactory ways to repair the injuries. Engine cylinders, for example, thought by the Germans to have been hopelessly broken, are being oxy-acetylene welded, rebored, and fitted with an inner steel lining. Many upper casings

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Fig. 1.—Condition of Boiler After Shell Was Removed

Fig. 4.—Combustion Chambers, Tube Sheets and Tubes Beyond Repair

of pumps and other essential parts had been taken off and thrown overboard, but in a number of cases it was possible to locate a similar pump with the casing or part intact. The perfect part could then be used as a pattern and new castings made to replace the missing or broken ones.

In their work of destruction, however, the Germans overlooked a number of things. Commutators of dynamos were damaged badly by being battered with sledges, but

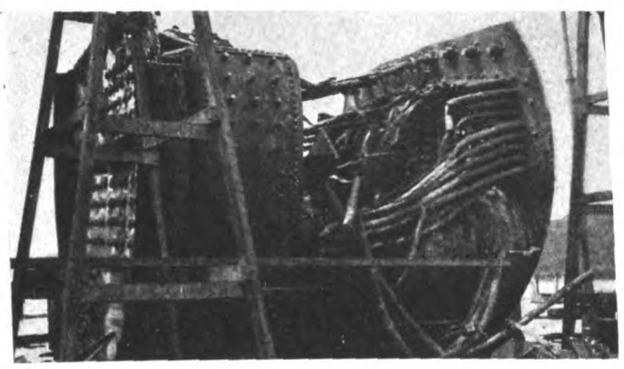

Fig. 2.—Tubes Completely Destroyed

on the same ships were found duplicate spare commutators, carefully boxed up with German thoroughness and in perfect condition to install in place of those wantonly broken. It is a rather curious coincidence, illustrative of the irony of war, that there is being used to a considerable extent in the repairs of these German boats two immense floating cranes, designed and made in Germany. German machinery in American hands repairing German destruction!

Anticipating having to deal with boats badly wrecked inside in an unserviceable condition, the Americans who

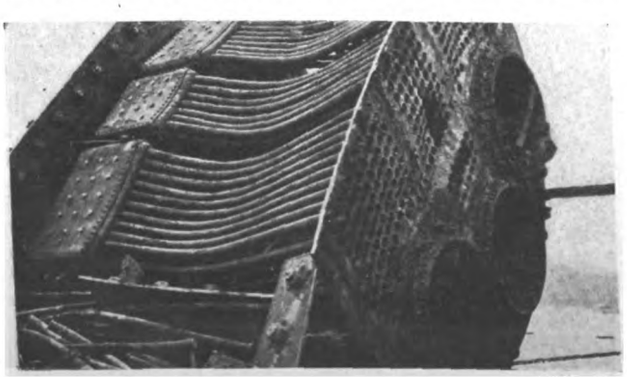

Fig. 3.—The Result of Dry Firing

went down to take them over took with them materials likely to be needed for temporary repairs. Among these were portable power pumps for keeping the bilges clear until the boats should be brought into port, and gasoline (petrol) electric light sets, similar to those used in country houses, to provide temporary lighting of the boats.

No steamer can run without its boilers; and while the boilers of all the ships were injured, the Germans made a particularly thorough job of destruction with some of them. The illustrations show some of the boilers damaged to a point of uselessness by "dry firing," the illustrations being taken after the boiler shell had been cut away. This destruction is accomplished by building an extremely hot fire in the boiler while it is unfilled by water. The inside is thereby distorted, the tubes sag and the boiler is in general seriously strained and injured, though usually not beyond the point where it can be made more or less serviceable by skilled workmen.

In the boilers shown, the Germans did the job with the thoroughness for which they are noted, and actually melted parts of the boilers. How they managed to accomplish it with the facilities at hand is a question. These boilers were, of course, beyond repair, and are being cut up by the aid of the oxy-acetylene torch for use as scrap steel.

It might seem to the layman that a far simpler method of destruction would have been simply to open the sea cocks and sink the ships at once. However, international maritime law has something to say on this subject. In war time a ship can be sunk in an enemy's harbor to obstruct traffic and it is considered legitimate warfare. But if a ship is deliberately sunk in a neutral harbor the circumstances are entirely different, for such a sinking constitutes an act of piracy and renders the crew of the vessel liable to the treatment accorded to pirates. The Germans, with due regard to their personal safety, therefore went as far as they dared, but no farther.

VAN ALLEN LYMAN.

A new edition of the Hand Book of Ship Calculations, Construction and Operation, by Charles H. Hughes, naval architect and consulting engineer (price $5), has just been published by D. Appleton & Company, New York. This edition is a revision of the book originally published in 1917 and contains many new tables, as well as changes that have been made necessary by advances in methods of ship construction and in marine engineering practice.

A fifth edition of Stromeyer's Marine Boiler Management and Construction (price $5) has just been published by Longmans, Green & Company, London and New York. No additions have been made to the last edition of the book.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Tank Top Ceiling

Q. (1016).—Describe a good method of laying ceiling on double bottom tanks, and also on tank side brackets.

A. (1016).—On top of the tank, which should have several coats of red lead, apply a thick coat of hot tar, and upon the top of this sprinkle cement.

A common method of laying ceiling is to use athwartship battens of, say, 2 inches by 8 inches, spaced about every two feet. Upon this the ceiling can be laid fore and aft of 2-inch yellow pine or 3-inch spruce. Where vessel is going to be unloaded by grab buckets, a double layer of ceiling is sometimes used, made up of athwartship spruce battens, a layer of 3-inch spruce fore and aft, and an athwartship layer of hard wood birch or maple, if obtainable. Many modern vessels have the inner bottom plating heavier in lieu of ceiling. I have heard of vessels having ceiling laid over tank top manholes without any corresponding hatch in the ceiling. Foremen having this work in charge should realize the trouble they may cause in neglecting this matter.

The ceiling along the tank side brackets is fastened to wood cleats bolted to the brackets. Yellow pine plank 3 inches by 10 inches may be laid fore and aft. Two of these planks should be removable for the length of hold, so that the filth which gathers here may be more readily taken away to prevent the pump suctions from becoming plugged.

Stresses in Shackles

Q. (1017).—Referring to the question on shackle design answered in the June, 1918, issue (question 964-2) I would like to ask the following questions:

Is it correct to consider the semi-circular part of the shackle bow as a portion of the ring when calculating the stresses therein? By the formula used in this connection by Goodenough and Moore, the stress in a 6-inch diameter bar is 12,000 pounds per square inch. In Machinery's Handbook the fiber stress in a 6-inch bar by the formula $S=1.621P\frac{D}{d^3}$ is 27,700 pounds per square inch. Solving for the necessary diameter of bar to give 12,000 pounds per square inch:

$$d=\sqrt[3]{\frac{P\,D}{0.617S}}=8.2 \text{ inches diameter.}$$

According to Athole J. Murray in his book "Strength of Ships" a fiber stress of 35,300 pounds per square inch would result from using a 6-inch bar. To reduce the stress by his method to 12,000 pounds per square inch, a bar 9½ inches in diameter would have to be used.

If the eye of the shackle is 2¼ inches thick and the shank where the eye is formed 1⅝ inches, Murray's method would indicate a stress of 53,000 pounds per square inch, at the former section and 41,700 at the latter.

Which of the above methods is most nearly correct? Is Murray's method based on the link theory mentioned in the answer of June 1918?

H. F. P.

A. (1017).—We may use one of many formulae for the strength of rings as a basis for calculating the bow:

A.—Goodenough and Moore. $P = 0.4\ C/S$, in which S is purely empirical, based on the results for chain tests. Because of the greater inside diameter, this would tend to everestimate the strength of a shackle bow.

B.—*Machinery*. $P = 0.617\ s\ \frac{d^3}{D}$. This is entirely theoretical, based on the assumption that the maximum bending moment in the ring is $\frac{PD}{2\pi}$ and the stress is found by the straight beam formula $s = \frac{My}{I}$.

C.—Simpson. Similar to *Machinery*, except that the maximum bending moment is that for a beam fixed at the ends with a concentrated load in the center $= \frac{PD}{8}$.

D.—Murray. Entirely theoretical. Bending moment by $\frac{PD}{2\pi}$. Stress found by curved beam formula. Theoretically the most correct method to use.

E.—Robson's Formula. Yield load $P = 42{,}000\ \frac{d^3}{D}$. This is rational, based on tests, and corresponds to a bending moment of about $\frac{PD}{13.5}$ and $s = \frac{My}{I}$.

F.—Method in Halsey's Handbook. Based on Bach's formula for curved beams and then corrected by an empirical constant found by test. This constant is 2 and doubles the load to cause a given stress.

The final answer to any strength calculation is: E or F of the above formulae are most nearly correct. By E for the shackle in question, the diameter would be 6½ inches for a stress of ¼ the yield stress 12,000 pounds per square inch, and by F 6 inches for 12,000 pounds per square inch.

Your attention is called to Murray, page 325, in regard to allowable stresses, if figured by his accurate method, ¾ of yield point, or 24,000 pounds per square inch, which you will note corresponds very nearly to Halsey's method of doubling the allowable stress.

In the case considered, I would recommend a diameter of 7 inches to allow for the difference between the shackle bow and a true ring.

You will find that almost any standard shackle will show high stresses at the eye when calculated according to Murray, yet there is no failure of the shackles under working load. If the apparent stress does exceed the yield point, the eye will stretch until it fits the pin exactly; then there can be no further bending stress. Tests of eyes with drilled holes nearly always show failure by direct tension.

Japanese Shipping Losses.—During the war 26 Japanese steamships, totaling 110,451 gross tons, were actually sunk, while 5 vessels of 17,964 gross tons are also regarded as having been sunk by German craft.

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Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

HANNEVIG TO BUILD SHIP REPAIR PLANT

Emergency Fleet Corporation Ends Pusey & Jones Embarrassment

Announcement has been made by Christoffer Hannevig, president of the Pusey & Jones Company, operating shipyards at Wilmington and Gloucester, of the building of an extensive repair plant at the latter yard involving the expenditure of at least $3,000,000 capital, which will be furnished by private Philadelphia interests. Three drydocks will be constructed, of 10,000, 6,000 and 3,000 tons lifting capacity. The company already holds 9,000 feet of water frontage, a suitable site for the new construction.

Public hearings have been held in Philadelphia to discuss the advisability of granting permission to the Pusey & Jones Company to extend 300-foot piers into the Delaware in connection with the project. Some opposition has arisen although a representative of the company explained that any other method of constructing the drydocks would involve additional expense.

Mr. Hannevig also recently announced that the Emergency Fleet Corporation has agreed upon a settlement involving several million dollars for work done by the company at its Wilmington and Gloucester yards, and has also advanced $2,500,000 to the company. All creditors' claims can therefore be settled as presented, and the possibility of receivership is eliminated.

Ten Scout Cruisers Contracted for by the Navy Department

Announcement has been made by Josephus Daniels, Secretary of the Navy, regarding the contractors for the ten scout cruisers which are provided for in the present building programme. Cruisers Nos. 4, 5 and 6 will be constructed by the Todd Dry Dock & Construction Corporation. The Bethlehem Shipbuilding Corporation has been awarded the contract for cruisers Nos. 7 and 8. The other five cruisers, 9, 10, 11, 12 and 13, are to be built by the William Cramp & Sons Ship & Engine Building Company.

Contract Let for Four Steel Tankers

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has received a contract from the Standard Transportation Company for four tank vessels. Two of these vessels, of 12,600 tons deadweight, will be built at the Fore River plant, Quincy, Mass.; the other two, of 10,100 tons deadweight, will be built at the Sparrow's Point plant, Sparrow's Point, Md.

Skinner & Eddy Corporation Orders Steel for Four 10,000-Ton Vessels

The Skinner & Eddy Corporation, Seattle, Wash., has placed an order for steel tonnage with Eastern mills, to be used in building four 10,000-ton cargo steamships for the corporation's own account.

CONTRACT FOR LARGEST BATTLESHIP AWARDED

Navy Department Buying Steel

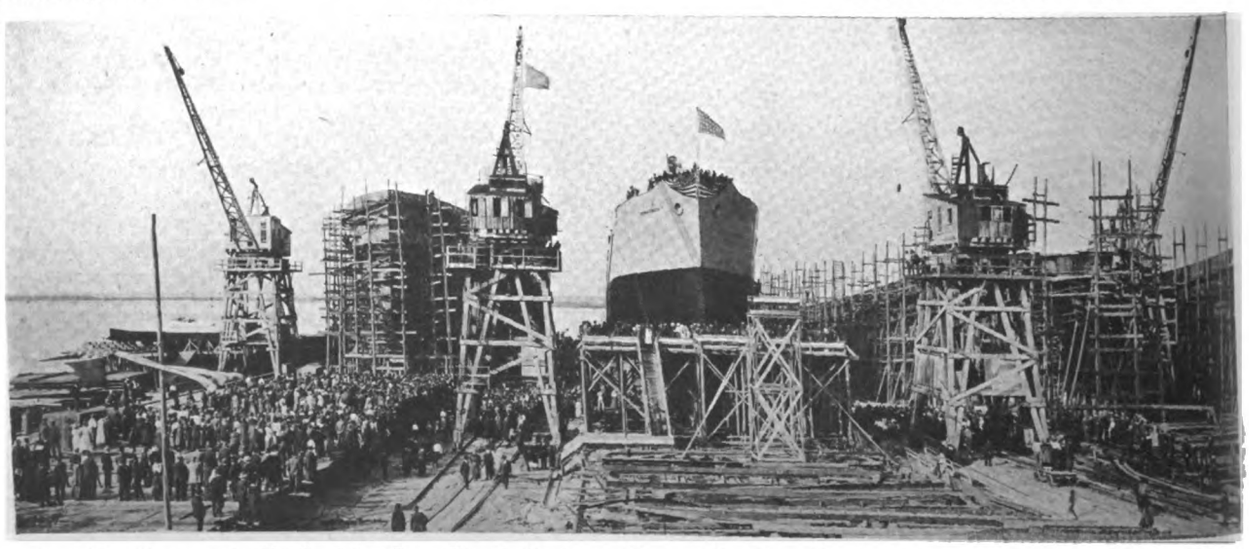
On July 11, Secretary Daniels awarded the contract for the building of battleship *No.* 53 to the Newport News Shipbuilding & Dry Dock Company, Newport News, Va. The cost of the vessel will be about $21,000,000.

The battleship will displace 43,200 tons, will be 684 feet in length, 104 feet beam on waterline, electrically driven by turbine and electric reduction gears, will develop 60,000 horsepower and burn oil for fuel. The ship will have a main battery of twelve 16-inch guns, a secondary battery of sixteen 6-inch guns, and will be equipped with two 21-inch submerged torpedo tubes.

The Navy Department has finally accepted the prices bid on 20,000 tons of plates, shapes and bars ordered for four battle cruisers and one fuel ship. The prices approved apply to 14,000 tons requisitioned from the Carnegie Steel Company, and for 6,000 additional tons for which bids were received.

Baltimore to Purchase Steel Vessels

A group of Baltimore bankers are cooperating with an unnamed New York steamship company for the purchase of a large number of the best type steel vessels, which they plan to operate out of Baltimore. As yet no formal statement has been issued by the Shipping Board, regarding the proposed deal.



Launching Scene at the Yards of the Oscar Daniels Company, Tampa, Fla. The Fourth 9,600-ton Ship *Seminole* Was Launched at These Yards on July 19

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CRAMP SHIPBUILDING COMPANY FIGURES IN NEW SHIPPING MERGER

Philadelphia Company to Be Center of Export and Building Corporation

According to a statement issued at Philadelphia, the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., and the Kerr Navigation Corporation, 17 Battery Place, New York, will be absorbed in the newly organized American Ship and Commerce Corporation, the holding company. The new company has been incorporated under the laws of Delaware with a capitalization (all of one class) of 1,500,000 shares of no par value. Not less than 300,000 shares are to be immediately syndicated and offered for sale at $40 per share.

Chandler & Company, Inc., 1328 Chestnut street, Philadelphia, the banking interests bringing about the merger, has announced that the new company will acquire a majority of the stock of the shipbuilding company, and a controlling interest in 50,000 tons deadweight capacity ocean steamships of the new Kerr Navigation Corporation.

"The present operating managements of the Cramp and Kerr companies will remain undisturbed. . . The American Ship and Commerce Corporation will also acquire directly or through subsidiary or associated companies an import and export business." After acquisition of the above interests the new company will have a substantial cash balance to develop international trade.

$200,000,000 Port Terminal Planned

Plans for the construction of a great terminal project off Bayonne, N. J., in New York harbor, affording facilities comparable only with Hamburg and Bremen, have been recently made public. The development calls for an expenditure of about $200,000,000.

The plan, which has been completed by James Stewart & Company, engineers, 30 Church street, New York, and E. P. Goodrich, consulting engineer, and approved, according to the announcement made, by George W. Goethals, President Besler, of the Central Railroad of New Jersey, and President Loomis, of the Lehigh Valley Railroad, is now up for approval before Major-General William C. Black, chief of the engineering staff of the army.

The "Jersey Flats" have been chosen as the site, embracing 1,100 acres of land under shallow water lying off Bayonne, and extending from Bedloe's Island to the Pennsylvania Railroad's Greenville terminal, including the solid rock reef known as Oyster Island.

Army Transport Delivered

The transport *Santa Elisa*, built for the Army by the New York Shipbuilding Corporation, Camden, N. J., was given her trial trip on June 12. Almost from the outset the 3,850-horsepower engines were working perfectly, and but little time was required to bring the number of revolutions up to 79 to 80 per minute. The average speed maintained down river and bucking a slight tide was 13.58 knots.

SHIPPING BOARD PLANS TO SELL SURPLUS AND SALVAGE PROPERTY

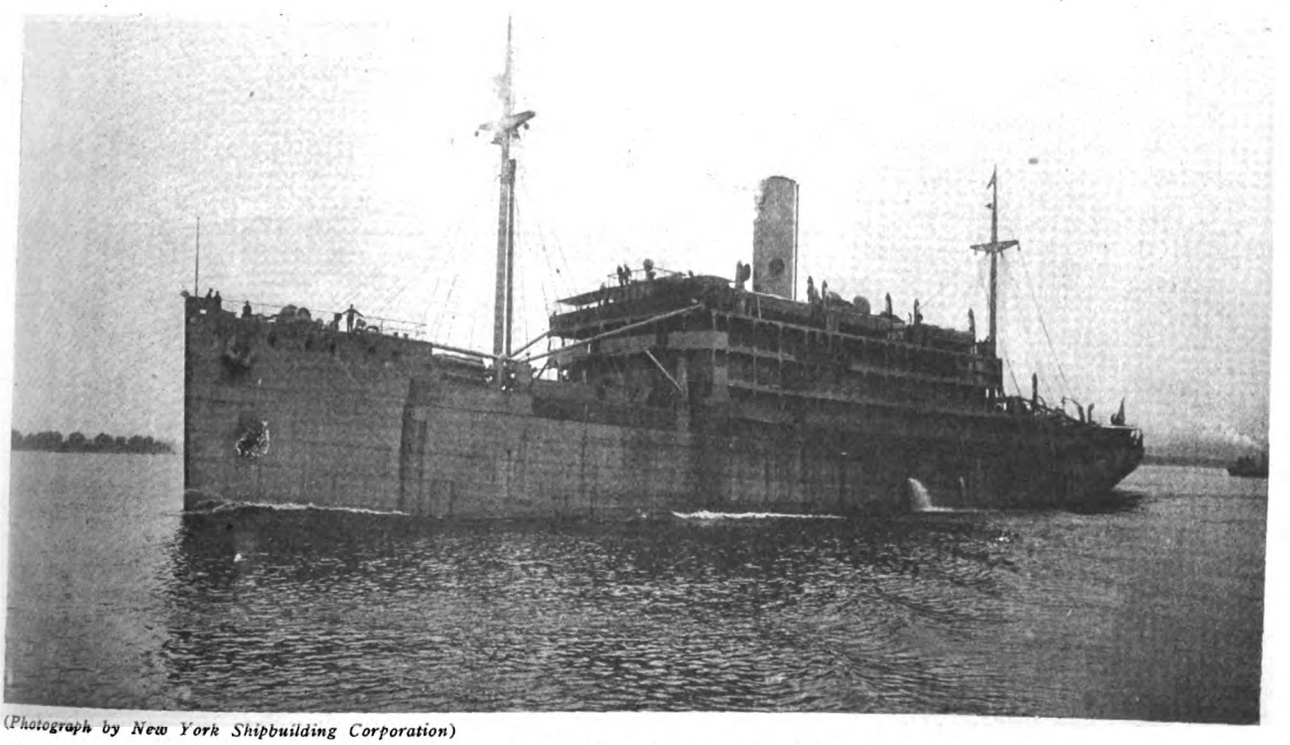
Ships, Shipyards, Drydocks, and Equipment Offered

The United States Shipping Board Emergency Fleet Corporation has arranged for the sale of its surplus and salvage property, including supplies, material and equipment, at such times and in such manner as may be deemed to be to the best interests of the corporation and the nation. Complete manufacturing plants, entire shipyards, drydocks, ships, complete or partially built, and miscellaneous materials including scrap metal will be disposed of by public sale.

The list includes marine railways housing and transportation projects, allotments of machinery, equipment and supplies, including wood-working machinery, machine tools and fixtures, electrical machinery, boiler and forge shop equipment, marine equipment and accessories, air compressor equipment, contractors' equipment and supplies, bridge and gantry cranes, steel plates, shapes and bars, pumping machinery, scrap metals, lumber, deck equipment, galley equipment, and hospital and commissary supplies.

SELLING POLICY

No open sale, where the original cost of the items covered by one transaction exceeds $5,000, will be final until approved by the Sales Review Board of the Corporation; where a sale is made at prices not lower than the minimum prices established by the Sales Review



(Photograph by New York Shipbuilding Corporation)

The Transport *Santa Elisa*, Which Left for Brest Immediately After Delivery to Bring Back American Soldiers. The Imperfection at the Bow is Not the Result of German Warfare, Only the Result of a Defective Film

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Board, such approval will not be necessary.

District managers of the Supply and Sales Division have been appointed to devote their attention to the problems arising out of the warehousing and sales programme in their districts. General information on any phase of the sales activities can be obtained from these representatives or from the home office of the Supply and Sales Division, Philadelphia.

SELLING AGENCIES

Completed ships.—United States Shipping Board, Washington, D. C.

Partially completed ships.—Secretary's Office, Emergency Fleet Corporation, Philadelphia, Pa.

Completed shipyards.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

Completed drydocks and marine railways.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

Completed manufacturing plants.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

Housing and transportation projects.—Transportation and Housing Division, Emergency Fleet Corporation, Philadelphia.

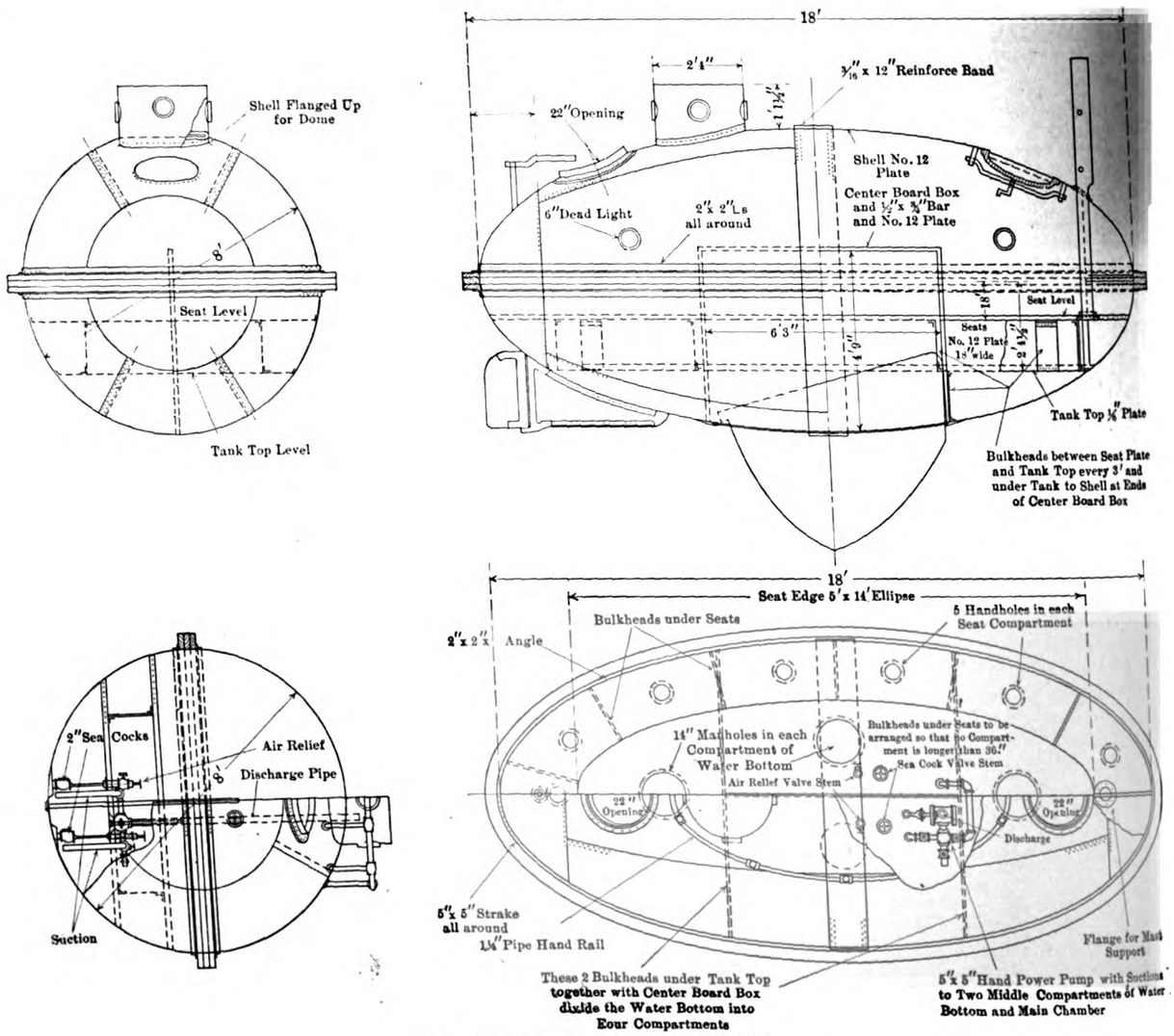
All property, materials and supplies not assigned to the foregoing will be disposed of by the Supply and Sales Division through its offices in Philadelphia or through the District Supply and Sales Offices in New York, Philadelphia, New Orleans, Chicago and Portland.

Brude Combined Lifeboat and Life Raft

The question of adequate life-saving facilities and equipment for ships constantly recurs, yet in spite of the lessons learned at great cost during the past four years from naval disasters, little effort has been made to increase the safety of sea travel.

Among other devices designed to accomplish this result, the Brude combined life boat and raft has been thoroughly tested in various shipwrecks and in all kinds of weather to determine its value. In general, the boat has the form of an ellipsoid, built up of steel plates and ballasted with water in four compartments, so that it cannot be capsized. It has a buoyancy of 18 tons and a capacity inside the hull for forty-four persons, while thirty more can find space within the railing on deck. Two manholes give access to the interior, and a small conning tower allows for observation when the hatches are down. Seats for forty people are fitted, and the lockers have capacity for a month's food supply for this number. Motive power is supplied by a small sail or by oars, and a centerboard may be fitted if necessary for beating into the wind.

Brude Lifeboat, Showing Open Hatch and Guard Rail


Shell Flanged Up for Dome
8′
Seat Level
Tank Top Level
18′
2′4″
22″Opening
11½″
3/16″ x 12″ Reinforce Band
Shell No. 12 Plate
Center Board Box and ½″x 3″Bar and No. 12 Plate
6″Dead Light
2″x 2″Ls all around
18″
Seat Level
6′3″
6′0″
Seats No. 12 Plate 18″wide
14½″
Tank Top ¼″ Plate
Bulkheads between Seat Plate and Tank Top every 3′ and under Tank to Shell at Ends of Center Board Box
2″Sea Cocks
Air Relief
Discharge Pipe
Suction
18′
Seat Edge 5′x 14′Ellipse
Bulkheads under Seats
5 Handholes in each Seat Compartment
2″x 2″ Angle
14″ Manholes in each Compartment of Water Bottom
Bulkheads under Seats to be arranged so that no Compartment is longer than 36″
Sea Cock Valve Stem
Air Relief Valve Stem
22″ Opening
22″ Opening
Discharge
5″x 5″Strake all around
1¼″Pipe Hand Rail
Flange for Mast Support
These 2 Bulkheads under Tank Top together with Center Board Box divide the Water Bottom into Four Compartments
5″x 5″Hand Power Pump with Suctions to Two Middle Compartments of Water Bottom and Main Chamber

Construction Details of the Brude Lifeboat

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This lifeboat is claimed to be non-swampable and non-sinkable, unless rammed by a ship or smashed against a rocky coast, nor can it be drawn down by the suction of a sinking ship, so that

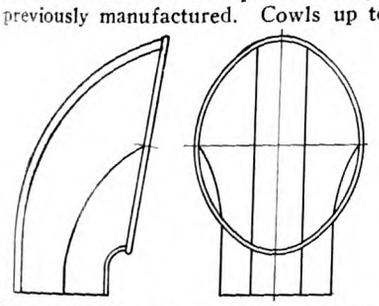
Brude Lifeboat Fitted With Sail

if time is not allowed for proper launching the Brude lifeboat may be left on deck until the vessel sinks under her. It has been dropped nearly 40 feet without apparent injury either to the hull or passengers inside.

The invention was developed in Norway, and for nearly two years has been compulsory equipment on certain ships sailing under the Norwegian flag. In this country the control is held by the Brude Life Boat Company of New York City, Konrad Furubotn, president.

Standardized Ship Cowls

To secure quantity production, the Ohio Blower Company, Cleveland, Ohio, has standardized the ship cowl design previously manufactured. Cowls up to



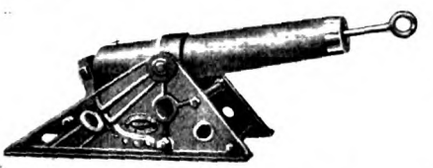
Standardized Ship Cowl. All Cowls Up to and Including 20 Inches Are Made in Four Pieces, 24 Inches and Larger Are Made as Shown

and including 20 inches are made in four pieces; cowls of 24 inches and over are construct as shown in the accompanying sketch. The arched design with few segments furnishes a cowl of rigid structure; and since the shape of the opening is varied but slightly in any section, from the inlet to the neck, and the curves are regular, the skin friction is almost negligible. In finishing the mouth of the "Swartwout" cowl, a piece of heavy pipe is slotted and welded to form an endless ring, which is forced over the mouth of the cowl and securely welded.

By riveting the cowl tube to the neck of the cowl so as to take a length equal to one and one-half times the diameter of the coaming tube, the cowl tube is limited to a short length, making hand operation easy, as the wind resistance is practically eliminated.

Galbraith Line Throwing Gun

A special line throwing gun is being placed upon the market by C. C. Galbraith & Sons, Inc., manufacturers of life-saving appliances, 90 West street, New York. This gun is of forged steel, mounted on a steel carriage. The projectiles weigh 18 pounds, and are turned to within a sixty-fourth-inch of the bore. The length of the latter is 27 inches with a diameter of 2½ inches. The lines are made in accordance with the



Galbraith Line Throwing Gun

rules and regulations of the United Steamboat Inspection Service to withstand a breaking strength of over 500 pounds. The full equipment includes 3 gun lines, 3 projectiles, 6 primers, 3 power charges, 1 lanyard, 1 ramrod and one-half dozen wads. The apparatus is known as the Galbraith line throwing gun.

Largest Oil Tanker Launched

The oil tank steamship *Fernando*, of 18,000 tons deadweight carrying capacity, said to be the largest oil tank steamer in the world, was launched recently by Messrs. Sir W. G. Armstrong, Whitworth & Company, Ltd., Newcastle-on-Tyne, England. This vessel is built to the order of the Eagle Oil Transport Company of London,

Metallo Gasket Company Locates at New Brunswick, N. J.

The Metallo Gasket Company has recently been incorporated for the manufacture of a line of gaskets and other packings at New Brunswick, N. J. The officers of the company are: Zeno Schultes, president and treasurer; Geo. Geipel, vice-president, and Stanley S. Geipel, secretary.

Zeno Schultes was manager of the Goetze Gasket & Packing Company for about fourteen years; George Geipel has been an erecting engineer for some thirty-five years, specializing in refrigerating and steam power plants, and Stanley S. Geipel has had ten years' experience in mechanical engineering. The company will concentrate for a time on its Metallo corrugated copper gasket with asbestos cord inlaid in the copper grooves or corrugations.

Locomotive Crane for Handling Coal and Bulk Materials

Efficient equipment for storing either hard or soft coal, as well as handling sand, ashes, broken stone, iron and other ores, is furnished by the revolving locomotive crane of the type illustrated. This apparatus is placed on the market by the McMyler-Interstate Company, Cleveland, Ohio. The locomotive crane, which is operated by steam or electricity, is equipped with a clam-shell bucket. It can be furnished with a 60-foot boom for operating at a radius at 45 feet, and is provided with couplers and air brakes. In operation the crane can store coal 30 feet high by means of a one-ton clam-shell bucket and can load a 50-ton truck in a few moments. Fifty-five to 70 tons can be handled per hour.

Locomotive Crane for Handling Coal and Bulk Materials

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Lehigh Appoints Chapman for New Marine Engineering Course

President H. S. Drinker of Lehigh University has announced the appointment of Lawrence B. Chapman as associate professor in the new course of ship construction and marine transportation which was instituted a year ago in the department of civil engineering.

Professor Chapman, a graduate in naval architecture and marine engineering at the Massachusetts Institute of Technology, taught for a time at the Institute, and was later assistant professor of mechanical engineering in the University of Maine. Since 1915 he has been on the technical staff of the Electric Boat Company, New London, Conn., engaged on technical problems of submarine design and construction.

The Lehigh course in ship construction and marine transportation prepares men to take part in the design and construction of ships and to enter the larger field of marine trade.

Civil Service Openings in the Marine Construction Field

The United States Civil Service announces the following competitive examinations: Schedule No. 343, inspector (male); examination scheduled for August 19; a vacancy is noted in the Public Works Department, Mare Island, Cal. Schedule No. 314, ship draftsman (male or female). Schedule No. 315, general engineering draftsman, architectural draftsman, power plant draftsman, heat and ventilating draftsman and electrical draftsman (male or female). Schedule No. 316, marine engine and boiler draftsman for internal combustion and aero engines, marine electrical draftsman and radio draftsman, (male and female). Schedule No. 317, ordnance draftsman (male and female). Schedule No. 318, aeronautical draftsman (male and female). Schedule No. 250, copyist draftsman (male and female). Schedule No. 356, supervising draftsman (male); examination scheduled August 19; a vacancy is noted in the Bureau of Steam Engineering, Washington, D. C.

Ferguson Steel & Iron Company Building Navy Tug Boats

The Ferguson Steel and Iron Company, Buffalo, N. Y., launched the third seagoing tug *Keewaydin* on its navy contract for six tugs, Wednesday, June 25. Of the two which have previously been launched one has been completely fitted out and accepted by the Navy Department, sailing from Buffalo on June 14.

These tugs are all steel, of 1,000 tons displacement. The machinery consists of two Scotch marine boilers and an 1,800-horsepower triple expansion reciprocating engine. The company is also constructing a wood tug for the State of Pennsylvania and has a contract to build a steel oil barge of about 1,000 tons displacement for private owners.

Gyroscope Exhibit

The Sperry Gyroscope Company, Brooklyn, N. Y., recently furnished an interesting exhibit at the Brooklyn Engineers' Club. Among the apparatus displayed was a 36-inch searchlight mounted in the center of the booth. The latter was lighted to its full candle power and automatically revolved, throwing a circular light around the roof of the armory in which the exhibit was held. A 15-inch marine type pilot house searchlight was also shown. A twin gyro-compass equipment was shown and kept in actual operating condition. The position of the panel and generator, pelorus and repeaters gave an idea of the flexibility of this system and also demonstrated how it is particularly adapted to merchant vessels. Demonstration of the gyroscope was obtained by the use of three small electrically-driven hand models. The production of this company has been practically controlled by the United States and Allied Governments during the war so that intimate knowledge of the company's products has not been available to the public before.

Duntley-Dayton Makes Foreign Connections

The Duntley-Dayton line of pneumatic and electric tools will be marketed in Europe and Australia by the Worthington Pump & Machinery Corporation through an arrangement which has just been made between Mr. W. O. Duntley, president of the Duntley-Dayton Company, and Mr. C. E. Wilson, manager of the foreign department of the Worthington people. The Worthington Pump & Machinery Corporation has branches in practically every European center, with a complete chain of agencies subsidiary to these branches.

BUSINESS NOTES

The Newhall Chain Forge & Iron Company, 90 West street, New York, has recently completed and placed in operation a section of its new shop at Garwood, N. J., for the production of high-grade dredge, crane, steam shovel and foundry sling chains. The accessibility of the Garwood factory, where hand welded heavy chains are produced for the metropolitan and coastwise trade, enables this company to be of special service.

The McMyler-Interstate Company, Cleveland, Ohio, announces the opening of a branch office in the Merchants Exchange building, San Francisco, Cal., in charge of L. A. Somers.

T. J. L. Crane, of the Wales Advertising Company, 110 West Fortieth street, New York, will sail for England on July 1. He will remain abroad for some time, in the interest of clients of the Wales Company.

The Washburne Engineering Company, 30 Church street, New York City, is operating as an engineering and contracting firm for drilling wells and installing suburban water supply systems. The company is particularly well equipped to build contracts on Long Island.

C. C. Cheyney, who served as a naval officer in charge of the mechanical repair shops of the Naval Aviation Station, Pensacola, Fla., during the war, has returned to the Buffalo Forge Company to take charge of the Chicago office and store.

J. W. McCabe, Buffalo manager of sales for the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill., has been appointed special representative for the company's foreign trade department to handle the business in the Orient, Philippine Islands and Australia. W. H. White will cover the Buffalo territory during Mr. McCabe's absence.

Preston Belvin has been appointed Pittsburgh district sales engineer of the International Oxygen Company, Newark, N. J. The company's offices are at 1310 First National Bank building, Pittsburgh, Pa. The Chicago office of the International Oxygen Company has been located at 30 North La Salle street, in charge of Philip G. Wesley.

Capt. H. H. Downes, Twelfth United States Engineers (railway), has returned from France, where he has been stationed since July, 1917. After receiving his discharge he will take charge of the Buffalo Forge Company's interests in the St. Louis territory.

J. J. Brown, formerly vice-president and general manager of the Wheeler Condenser & Engineering Company, Carteret, N. J., was elected president of the company on July 8. H. S. Brown, 50 Congress street, Boston, Mass., was elected vice-president.

R. E. Lovekin, formerly managing director of the American Screw Propeller Company and authority on engineering advertising, has disposed of his interests in the American Screw Propeller Company, and has opened offices at 610-11-12 Penfield Building, Philadelphia, Pa., under the name of R. E. Lovekin, advertising engineer. Mr. Lovekin's experience in engineering and advertising and his acquaintance among shipyard officials and marine engineers fit him especially for work in this field.

R. Lester Thayer has been appointed Philadelphia District Manager of the Wayne Oil Tank and Pump Company, with offices in the Otis building.

C. D. Clary, who has been connected with the Western Electric Company since 1910, at the Philadelphia and Pittsburgh offices, has been made sales manager of the Pittsburgh office.

On June 25-28 a sales convention of the Buffalo Forge Company, Buffalo, N. Y., was held at the country place of the president, H. W. Wendt, Sr. Discussions were carried on regarding the construction of apparatus, built in Buffalo, and other business connected with the affairs of the company.

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Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

PROSPECTIVE SHIP CONSTRUCTION

100 to 300-ton Vessels for Tropics.—F. C. Luthi & Company, Inc., 277 Broadway, New York, wishes to connect with a shipbuilder able to design and construct small steamers or motor boats for cargo and deck passenger tropical coastwise trade. Vessels of 100 to 300 gross tons only are required; cheapness of construction and operation are important considerations.

8,000-Ton Steel Vessels.—J. Fred Larson, vice-president of the Pacific International Trading Company, and director of the Columbia Pacific Company, accompanied by eleven representatives of Scandinavian countries, it is reported, is scheduled to come to Portland, Ore., to carry out negotiations for tonnage to be placed for these interests. Mr. Larson has the authority to contract for the construction of eight steel ships to be used in trade between the Pacific Coast and Northern Europe.

20,000-Ton Ocean Steamships.—The Nippon Yusen Kaisha, 120 Broadway, New York, according to unofficial reports, plans to build three 20,000-ton steamships for the proposed Seattle-Orient passenger service. The first of these will probably be built in England, to be used as a model for the other vessels to be laid down in Japan. It is also understood that the company proposes to build two or three 6,000-ton ships for service between Shanghai and European ports.

Fireboat, Norfolk, Va.—The city of Norfolk, Va., is planning to purchase a fireboat. Funds are now being collected from railway interests and waterfront property holders. About $250,000 will be expended for the vessel. Details may be obtained from City Manager Ashburne.

SHIP CONTRACTS

Armstrong, Whitworth & Company, Newcastle, N. S. W., has received orders from the Cunard Company for two large steamers of the intermediate class, and an order from the Peninsular & Oriental Company for a large passenger steamer.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has received a contract from the Standard Transportation Company for four tank vessels. Two of these vessels, of 12,600 tons deadweight, will be built at the Fore River plant, Quincy, Mass.; the other two, of 10,100 tons deadweight, will be built at the Sparrow's Point plant, Sparrow's Point, Md.

The Bethlehem Shipbuilding Corporation, Fore River, Mass., has received a contract to build two cruisers, Nos. 7 and 8, for the Navy Department.

The Clinton Shipbuilding Company, Philadelphia, Pa., will build a steel harbor oil barge of 12,000 gallons capacity for the Union Petroleum Company.

The Coastwise Shipbuilding Company, Baltimore, Md., is building the following vessels at its yards: three 2,500-ton coal carrying barges for the United States Shipping Board, a 75-foot motor fishing vessel for a Camden owner, a 175-foot tug for the Northern Transportation Company and four 2,000-tons schooners for the Chesapeake Transportation Company.

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has received a contract to build five cruisers, Nos. 9, 10, 11, 12 and 13, for the Navy Department.

The Defoe Boat and Motor Works, Bay City, Mich., is constructing six 100-foot steel tug boats.

The East Coast Fisheries Company, 7 Wall street, New York, has placed orders for the building of five all-steel steam trawlers. Two of these ships will be built by the J. W. Sullivan Company, Elizabethport, N. J.; two by Kyle & Purdy, City Island, N. Y.; and one by the Ohio Shipbuilding Company, Cleveland, Ohio.

The Hanlon Dry Dock & Shipbuilding Company, East Oakland, Cal., according to a San Francisco report, has received an order to convert three 6,000-ton vessels now building at the yard into motorships, equipping them with twin engines of 1,000 horsepower. These engines are of the Werkspoor design of Dutch origin. The patents were obtained from Holland by t' Skandia Engine Company, Oakland, Cal.

The Fred T. Ley Company, Inc., Mobile, Ala., has been given the contract to outfit all concrete vessels built at the Mobile yards, according to an announcement by Robert W. Boyd, assistant in the concrete section, United States Shipping Board, Emergency Fleet Corporation.

The McDonald Engineering Company, Chicago, Ill., is constructing ten concrete ships for the French & Canadian Transportation Company at Port Aransas, Tex. Each vessel, which will cost approximately $200,000, will be 300 feet long, 53 feet wide and 21 feet deep. Each vessel will have a deadweight capacity of 2,200 tons and carrying capacity of 14,000 or 15,000 barrels.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., on July 11, was awarded the contract for the building of battleship No. 53 by Secretary Daniels. The cost of the vessel will be about $21,000,000.

The New York Shipbuilding Corporation, Camden, N. J., has laid keels for three 535-foot vessels at the Gloucester yards for the Emergency Fleet Corporation.

The Todd Dry Dock & Construction Corporation, Tacoma, Wash., has received a contract to build three cruisers, Nos. 4, 5, and 6 for the Navy Department.

The Transatlantic Shipping Company, Gothenburg, Sweden, has now an order with the Gotaverken Shipbuilding Company, Gothenburg, Sweden, for constructing ten motorships. Two of these ships have already been delivered. Of the remaining eight, one will be an oil tanker, 400 feet long, 55-foot beam, with a loaded draft of 24 feet. The dimensions of the other vessels are as follows: Length overall 440 feet, 56-foot beam, and with a loaded draft of 26 feet.

The Union Shipbuilding Company, Fairfield, Md., has a contract to build two 328-foot vessels for the Aluminum Company of America. These ships have a 46-foot beam, and are 24 feet 3 inches deep, with a deadweight carrying capacity of 4,677 tons each.

The Union Steamship Company of New Zealand, Australia, it is reported, has placed an order with a Clyde shipbuilding concern for the construction of a 14,000-ton passenger vessel to operate between Vancouver, B. C., and Australia.

Messrs. Vickers, Ltd., England, have received a contract from the Donaldson Line, Ltd., Glasgow, Scotland, for the construction of an 8,000-ton deadweight ocean-going steamer.

Messrs. J. Samuel White & Company, Ltd., England, has secured a contract to build twelve 200-ton steel barges for Messrs. Cory & Son.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Crane Runways, Brooklyn, N. Y.—McClintic Marshall Company, 715 Munsey building, Washington, D. C.,

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has entered the lowest bid for furnishing crane runways for shipbuilding slip No. 1 and for bulkhead handling, etc., at the New York Navy Yard, Brooklyn, N. Y.

Drydock, Brooklyn, N. Y.—Harry Cossey, Staten Island, is constructing an 8,800-ton floating drydock for the Clinton Dry Docks Company, a subsidiary of the Todd Shipyards Corporation, Clinton street, Brooklyn. When completed the dock will have an overall length of 428 feet, be 114 feet wide, and capable of handling vessels up to 500 feet long. The company is also building one 800-foot and one 600-foot pier at this site.

Drydock, Hoboken, N. J.—The W. & A. Fletcher Company, Hoboken, N. J., has announced the placing of contracts for an 8,500-ton floating drydock to be constructed at the New Jersey plant. The pontoons will be built by John Monks & Sons, 82 Beaver street, New York city.

Drydock, Jacksonville, Fla.—H. R. Dillingham, Heard building, Jacksonville, Fla., district plant engineer of the United States Shipping Board, may be addressed concerning the purchase of a floating drydock being constructed at Jacksonville, Fla., which will be sold to the highest bidder upon completion. At least $500,000 will be expended for construction and equipment before the dock is ready for operation.

Drydock, Mill Basin, Brooklyn, N. Y.—The Atlantic Gulf & Pacific Company, 13 Park Row, New York, has received a contract from the Emergency Fleet Corporation to build a 14-pontoon drydock at Mill Basin, Brooklyn. Construction will be of wood throughout, each pontoon being 80 by 116 feet. Wing walls are 45 feet high. The dock will be arranged in sections to accommodate vessels of 10,000 to 12,000 tons, each section accommodating approximately 2,000 tons. The pontoons will be operated by electrically-driven pumps. All material is being supplied by the Emergency Fleet Corporation, which will operate the drydock on completion.

Drydock, Pensacola, Fla.—The Aberthaw Construction Company, Boston, Mass., has received a contract for the construction and equipment of a 5,000-ton drydock of the Crandall type, to be built at Pensacola, Fla. This dock, which will cost about $450,000, will consist of five floating pontoons, each 100 by 20 feet, 10 feet deep. Each of the pontoons will be equipped with four electric centrifugal pumps, designed to empty the dock in one hour.

Drydock, Savannah, Ga.—Four pontoons of the new 8,000-ton sectional floating drydock, designed by the Crandall Engineering Company, Boston, Mass., which is being built for the Savannah Dry Dock & Repair Company, Port Wentworth, Savannah, Ga., are about complete.

Drydock and Buildings, Sorel, Quebec, Canada.—The Sorel Shipbuilding Company, Sorel, Quebec, Canada, plans to construct a drydock and necessary buildings. About $150,000 will be expended on the construction. J. N. Leclair, Sorel, Quebec, is the engineer.

Drydock and Harbor Improvements, Courtnay Bay, St. John, N. B.—The St. John Dry Dock & Shipbuilding Company, Ltd., St. John, N. B., has received a contract from the Dominion Government for the construction of harbor improvements at Courtnay Bay, which will cost about $5,000,000. These developments include the construction of a breakwater, entrance channel, basin and quay wall. In conjunction with this work the company is building for its own use a drydock 1,150 feet in length with a width of 125 feet and a depth of 40 feet at high water. H. R. Dufresne is manager.

Drydock and Machine Shop, Mariners' Harbor, Staten Island.—The Brewer Dry Dock Company, Mariners' Harbor, Staten Island, has practically completed a new steel and brick machine shop, 50 by 80 feet. An inside gallery was built by John Milnes Company, Port Richmond, S. I. When finished the structure will be equipped to handle all kinds of marine repairs. The company also plans to build a drydock 400 feet long by 100 feet wide. The structure will take a vessel of 6,000 tons.

Drydock Pontoon and Dredge Hull, Portland, Ore.—The Port of Portland Commission, Portland, Ore., closed bids on July 10 for the construction of the sixth pontoon for the St. Johns drydock. Bids were accepted only from plants in the Port of Portland district. Bids from the same locality were opened on July 24 for the construction of a hull for the dredge **Columbia** operating in this region.

Drydocks.—The Narragansett Shipbuilding Company, Tiverton, R. I., the Kingston Shipbuilding Company, Kingston, N. Y., and the Arverne shipyard, managed by W. H. Gahagan, Arverne, L. I., are building large drydocks for the Emergency Fleet Corporation. Official word has not been received, but it is supposed that these drydocks will be operated by the Ramberg Iron Works, Inc., Brooklyn, N. Y.; the Perth Amboy Dry Dock Company, Perth Amboy, N. J., and Fraser, Brace & Company, New York.

Marine Electrical Equipment Factory, Seattle, Wash.—The Horne Manufacturing Company, Brooklyn, N. Y., is establishing a factory for the manufacture of marine electrical equipment in Seattle, Wash. The company's present offices are located at 222 Grand Trunk Pacific building, Seattle, Wash.

Pattern Shop, Philadelphia, Pa.—N. H. McClosky, 1620 Thompson street, Philadelphia, Pa., has entered the lowest bid for the construction of a pattern shop at the Navy Yard, Philadelphia, Pa.

Propeller Wheel Factory, Albany, N. Y.—The Thacher Propeller & Foundry Company, Albany, N. Y., recently incorporated, with an actual capital of $1,000,000, will take over the business conducted by George H. Thacher & Company, North Albany. The essential purpose of this new incorporation is to push the marine business, particularly the patent process of propeller wheel manufacture. The company has let a contract for a new building to be constructed at the plant to cost between $150,000 and $200,000.

Ship Repair Plant, Gloucester, N. J.—Announcement has been made by Christoffer Hannevig, president of the Pusey & Jones Company, operating shipyards at Wilmington and Gloucester, of the building of an extensive repair plant at the latter yard involving the expenditure of at least $3,000,000 capital, which will be furnished by private Philadelphia interests. Three drydocks will be constructed of 10,000, 6,000 and 3,000 tons lifting capacity. The company already holds 9,000 feet of water frontage, a suitable site for the new construction. Public hearings are now being held in Philadelphia to permit the company to build 300-foot piers. The proposition has met with opposition.

Ship Repair Plant, Staten Island, N. Y.—Fraser, Brace & Company, 1328 Broadway, New York city, has begun the construction of a ship repair plant which it will operate at Staten Island, N. Y. The plant will include a sectional drydock of 10,000-ton capacity, piers and all the necessary equipment for adequate ship repair work. The drydock will be operated by electrically-driven centrifugal pumps.

Ship Repair Plant, Wilmington, Del.—The Keystone Ship Repair Company has been incorporated by T. L. Corteau, P. B. Drew and C. L. Rimlinger, Wilmington, Del., with a capital of $100,000.

Shipbuilding Ways, Brooklyn, N. Y.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract for reconstructing shipbuilding ways in Brooklyn, N. Y., to the Phoenix Construction Company, 41 Park Row, New York City, for $697,897.

Shipfitters' Shop, Boston, Mass.—Levering & Garrigues, 552 West Twenty-third street, New York city, has entered the lowest bid for the construction of the addition to the shipfitters' shop to be built at the Navy Yard, Boston, Mass.

Shipyard, Camden, N. J.—The Penn Shipyards Corporation, Camden, N. J., has been incorporated by Robert D. Hughes, Camden, N. J., Samuel Edelman, Philadelphia, Pa., and David McKnight, Jr., Palmyra, Pa., with a capitalization of $1,000,000, to build vessels, engines and ship equipment.

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Shipyard, Morehead City, N. C.—Edward S. Meadow & Company, Newbern, N. C., has taken over the Shipping Board's shipyard at Morehead City, N. C.

Shipyard, Newport News, Va.—The Southern Shipyard Corporation, Newport News, Va., which has been organized with a capital of $200,000, is planning to build a new yard at Newport News, Va. The plan will include a Crandall Marine railway of 3,000 tons capacity and several smaller ways. Sanford & Brooks Company, Baltimore, Md., has been awarded the contract for constructing a 3,000-foot bulkhead and a pier 500 feet by 40 feet, and the Truscon Steel Company, Youngstown, O., has received a contract to build six steel structures with concrete floors.

Shipyard, Portland, Me.—The Job Shipyard Corporation has been incorporated to build vessels. R. L. Johnson, president, Portland, Me.; H. I. Smith, treasurer, Portland, Me.; A. B. Farnhamn, clerk, Portland, Me.

Shipyard, Racine, Wis.—The Badger Boat Company, Racine, Wis., has been incorporated, with a capital of $10,000, by Martin Draeger, William Draeger and Clarence Bornofski.

Shipyard, Shanghai, China—A Chinese concern, known as the Sung Fuh Yue Company, has recently purchased seventeen acres near the arsenal at Shanghai, China, on which it is planned to erect a modern shipyard.

Shipyard Extension, New York—The Underpinning & Foundation Company, 290 Broadway, New York City, has entered the lowest bid for the rebuilding of a shipbuilding way at New York, as called for in the specifications issued by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Wood Shipyard, Mount Pleasant, S. C.—The E. O. Hall Boat Yard Company, Mount Pleasant, S. C., has been incorporated by Walter B. Wilbur and others, with a capital of $10,000, to construct wooden ships.

PROPOSED CONSTRUCTION

Breakwater, Racine, Wis.—P. H. Connolly, Racine, Wis., is receiving bids for the building of a breakwater at Racine to extend about 2,500 feet.

Canal, New Orleans, La.—The United States Engineer Office, Custom House, New Orleans, La., is planning to construct a six-mile canal from Bayou Teche to Vermillion River, to cost about $350,000.

Coal Dock, Duluth, Minn.—The Northwestern Fuel Company plans to build a 1,000,000-ton coal dock. This will be 1,500 feet long and 500 feet wide, and will cost about $1,000,000. The dock will be equipped with a 500-foot span Brownhoist bridge and a 10-ton clam-shell bucket.

Coaling Wharf, New Orleans, La.—The United States Naval Station situated at New Orleans, La., plans to increase the present coaling wharf. About $90,000 will be spent for the work.

Concrete Unloading Dock, St. Joseph, Mo.—The St. Joseph Warehouse & Cold Storage Company, St. Joseph, Mo., will extend a concrete unloading dock. Structure to cost about $20,000.

Dock, Parkersburg, W. Va.—The Ohio River Dock Company, Parkersburg, W. Va., is planning the construction of a dock at that city. The company, which is capitalized at $50,000, has been formed by H. A. Winters and C. D. Dodson.

Docks, Baton Rouge, La.—The Aluminum Ore Company, St. Louis, Mo., it is reported, is planning to build extensive docks at Baton Rouge, La., which will be used as a shipping port for South American trade. The company denies that any definite proposition is now being considered.

Dredging, Gray's Harbor, Wash.—The Port Commission, Gray's Harbor, Wash., will spend $10,000 for improvements, and such further sum as may be necessary in order to deepen the channel of the inner harbor, the main shoal of which is opposite Gray's Harbor city.

Dredging and Rock Removal, East River, N. Y.—The United States Engineer Office, Room 710, Army building, 39 Whitehall street, New York, will receive sealed proposals for dredging and rock removal in the East River, N. Y., until 12 noon, August 7, 1919. Further information on application.

Drydock, Brooklyn, N. Y.—The Navy Department, Washington, D. C., is arranging for an appropriation of about $6,000,000 for the reconstruction and improvement of drydock No. 3, at the New York Navy Yard, Brooklyn, N. Y. This will include ship construction and repair facilities.

Drydock, Oswego, N. Y.—The A. R. Hinckley Company, Oswego, N. Y., is planning the erection of a new ship repair plant estimated to cost about $100,000. The new plant will include machine tools and machinery for ship repairs and construction, drydock, marine railway, cranes, hoisting machinery, etc. Construction is postponed, however, temporarily, pending the action of the State in granting property for the company's use.

Fill, Astoria, Ore.—Bids have been opened at Astoria, Ore., for the filling in of reclamation district No. 3, which will be used for the development of several large harbor projects.

Freight Shed, Rothesay, N. B.—C. R. Brown, Moncton, N. B., is receiving bids for the construction of a freight shed at Rothesay, N. B., to cost about $100,000.

Harbor Improvements, Berkeley, Cal.—R. P. Jennings, Berkeley, Cal., has leased the Berkeley waterfront with the exception of 100 feet, for fifty years, and plans to spend $2,000,000 within five years and $1,000,000 additional within ten years of signing of lease to build piers or moles and warehouses.

Harbor Improvements, Charlotte, Fla.—Government engineers have recommended to Congress that the authorized improvements at Charlotte harbor, Fla., be enlarged so as to provide a channel 47 feet deep and 300 feet wide from the Gulf of Mexico to the town of Bocagrande. The increased cost is estimated at $100,000.

Harbor Improvements, Newport Beach, Cal.—The Board of Supervisors, Orange County, Santa Ana, Cal., has appropriated the following amounts to improve the harbor of Newport Beach, Cal: $137,000 for cutting new channel for the Santa Ana River through sand; $270,000 for dredging channel in bay; $43,000 for wharf, warehouse and railroad connection; $50,000 for extending rock jetty. Leeds & Barnard, Central building, Los Angeles, Cal., are the engineers in charge of the work.

Harbor Improvements, Tacoma, Wash.—One million five hundred thousand dollars' worth of bonds have already been sold for the $2,500,000 harbor improvements planned by Tacoma, Wash. An initial expenditure of $350,000 will be used for fills, riprapping and piling.

Lining Concrete Drydock, Paris Island, S. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to line a drydock at Paris Island, S. C., with concrete. About $25,000 will be spent on the project.

Loading Dock, St. Helens, Ore.—The St. Helens Dock & Terminal Company, St. Helens, Ore., plans to construct a 2,500-foot loading dock. Further details regarding the work may be obtained from H. F. McCormick, St. Helens Lumber Company, St. Helens, Ore.

Machine, Electrical, Pattern, Steel and Lumber Storage Shops, Norfolk, Va.—The House Naval Appropriation Bill carries $400,000 for machine and electrical shops, $400,000 for a pattern shop, and $300,000 for a steel and lumber storage shop, all of which are to be constructed at the Norfolk Navy Yard, Norfolk, Va.

Pier, Burlington Channel, Can.—The Department of Public Works, Ottawa, Ont., plans to construct a 200-foot pier at Burlington channel to cost about $24,000.

Pier and Yacht Basin, Gulfport, Miss.—The Pinellas Company, Gulfport, Miss., is planning to build a 500-foot pier and yacht basin. This will also be used as a commercial dock.

Pier and Warehouse, San Diego, Cal.—F. A. Rhodes, city engineer, San Diego, Cal., may be addressed concerning construction details of a new pier and warehouse which the city plans to build.

Power Plant, Boston Navy Yard—

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The House Naval Appropriation Bill carries $100,000 for a power plant to be constructed at the Boston Navy Yard.

Rolling Mill, Sydney, Nova Scotia.—The Federal Government of Canada, according to an announcement by C. C. Ballantyne, has issued to the Dominion Steel Company a contract for 250,000 tons of ship plates. This order will involve the construction of a large rolling plant at Sydney, Nova Scotia, to cost about $5,000,000.

Sea Wall, Rockwood, Mich.—W. H. Adams, Vinton building, Detroit, Mich., may be addressed concerning the construction of a sea wall at Rockwood, Mich., to cost about $20,000.

Ship Channel, Beaumont, Tex.—The Beaumont Navigation District, Beaumont, Tex., has advertised the sale of $300,000 in bonds for the purpose of improving the ship channel.

Shipping Docks, Texas City, Tex.—The Humble Oil & Refining Company, W. S. Farish, vice-president, Houston, Tex., will construct new shipping docks in Texas City, the capacity of which will be 20,000 barrels.

Shipyard Improvements, Power Plant, Pattern Shop, etc., Philadelphia, Pa.—The House Naval Appropriation Bill carries $1,000,000 for general developments, $500,000 for a power plant, and $400,000 for a pattern shop, to be constructed at the Philadelphia Navy Yard, Philadelphia, Pa.

Steel Storage Plant, Brooklyn, N. Y.—The House Naval Appropriation Bill carries $200,000 for a steel storage plant to be constructed at the New York Navy Yard, Brooklyn, N. Y.

Steel Warehouse, New Orleans, La.—James W. Porch, of the Lukens Steel Company, 626 South Peters street, New Orleans, La., has announced that the Lukens Steel Company, one of the eleven companies forming the Consolidated Steel Corporation, will build a $300,000 steel warehouse at that port to retain steel for export purposes.

Terminal, Bayonne, N. J.—Plans for the construction of a terminal project off Bayonne, N. J., in New York harbor, affording facilities comparable with Hamburg and Bremen, have been recently made public. The development calls for an expenditure of about $200,000,000. James Stewart & Company, 30 Church street, New York, is the consulting engineer. The proposition has the approval of George W. Goethals, President Besler, of the Central Railroad of New Jersey, and President Loomis of the Lehigh Valley Railroad.

Terminal, Dorchester Bay, Mass.—George P. Hamlin, Boston, Mass., has recently outlined a plan for a large terminal development upon Dorcester Bay, which would co-ordinate all the railroads of Boston into an inner and outer belt line. This scheme would provide a more efficient approach to the army base at South Boston, and the auxiliary navy yard at Squantum. Dorchester has practically a straight roadway to the sea, and is within communication distance of the above development and of the New Haven Railroad wharves and yard.

Warehouse, Seattle, Wash.—The Seattle Warehouse Company, 107 Jackson street, Seattle, Wash., has received a building permit to construct two $200,000 warehouses in the new industrial district. The site of the warehouses, which is on the county dock property, will make it possible to connect the structures with the Duwamish waterway, also with the railroad spur on East Marginal way.

Wharf, Coos Bay, Ore.—The port of Coos Bay, Ore., is negotiating for one of two harbor sites upon which it is proposed to build a large public wharf with adequate rail connection. Large warehouses will be constructed The work is in charge of James Polhemus. Coos Bay has already expended $600,000 in deepening the harbor.

Wharf, Darien, Ga.—The city of Darien, Ga., has voted $10,000 for the construction of a municipal wharf.

Wharf and Elevator, Monroe, La.—Walter G. Kirkpatrick, consulting engineer, Monroe, La., may be addressed concerning a municipal wharf and elevator to be constructed at that place.

Wharves, Equipment and General Improvements, Vancouver, B. C.—The Dominion Government has appropriated $5,000,000 for general improvements to the harbor at Vancouver, B. C., including wharves and equipment. R. G. Swan, Ottawa, Ont., is the engineer.

EQUIPMENT

Boilers and Superheaters, Charleston, S. C.—The Heine Safety Boiler Company, 1120 Pennsylvania building, Philadelphia, Pa., has received a contract to install boilers and superheaters at the Charleston Navy Yard, Charleston, S. C., to cost about $41,750.

Bridge and Wall Cranes, Mare Island, Cal.—Bids have been asked for furnishing and installing one 80-ton, four 15-ton and two 5-ton bridge cranes, together with fourteen 5-ton and six 3-ton wall cranes in the new structural shop at the Mare Island Navy Yard. The estimated cost is $250,000.

Cranes, Brooklyn, N. Y.—Niles-Bement-Pond Company, 111 Broadway, New York City, entered the lowest bid for the furnishing of cranes at the New York Navy Yard, Brooklyn, N. Y., to cost $85,165.

Elevators, New York.—The Albro Clem Elevator Company, D street and Erie avenue, Washington, D. C., has entered the lowest bid for furnishing elevators at New York, as called for in the specifications issued by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Machinery and Boilers, Glasgow, Scotland—Messrs. Cammell Laird & Company, Ltd., Birkenhead, has received from Napier & Miller, Glasgow, an order for two sets of geared turbine machinery of the double reduction type, together with boilers fitted for burning oil fuel for two steamers of 9,500 tons, which they are biulding for the Norwegian-American Line of Christiania.

Shafting and Machinery Installations, Hoboken, N. J.—Frank Tracey, 202 Center street, New York city, has received a contract from W. & A. Fletcher Company, Hoboken, N. J., for shafting and machinery installations on the 8,500-ton floating drydock to be constructed at the New Jersey plant.

Steel Wings, Hoboken, N. J.—The American Bridge Company, Pittsburgh, Pa., has received a contract from W. & A. Fletcher Company, Hoboken, N. J., to furnish the steel wings for the 8,500-ton floating drydock to be constructed at the New Jersey plant.

Trailers and Trucks, New York City.—Bids were closed on July 15, by E. S. Walsh, Superintendent of Public Works, Albany, N. Y., for furnishing, delivering and testing industrial freight handling trailers and stevedore freight handling trucks for the barge canal terminal at New York City. Contract has been awarded to the Lansing Company, 492 Broome street, New York City, for $9,250.

CONSTRUCTION CONTRACTS LET AND PENDING

Boat Shops and Concrete Floor, San Francisco, Cal.—The Board of State Harbor Commissioners, San Francisco, Cal., has recently let two contracts—one for the building of the Fisherman's Boat Shops at Fisherman's Lagoon, and the other for the laying of a concrete floor and foundation to be used in connection with the proposed vegetable oil plant at Islais Creek.

Boathouse, Wharf and Boat Basin, Galveston, Tex.—Bids were closed on July 31, by the Treasury Department, Washington, D. C., for the building of a new boathouse, wharf and boat basin for the United States Quarantine Station, Galveston, Tex. J. A. Wetmore is the supervising architect

Bulkhead, Passaic River, N. J.—Linde & Griffith, Fourth street, Newark, N. J., has received a contract to build a bulkhead on the Passaic River at the cost of $16,500.

Concrete Retaining Wall, St. Louis, Mo.—The M. Cates Stock Company Syndicate Trust building, St. Louis,

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Mo., has let a contract to J. W. Strupps Company, 240 Second street, Kansas City, Mo., for the construction of a reinforced concrete retaining wall, 4 miles long and 20 feet high, 30 miles northwest of St. Louis.

Dock, Choctaw Point, Fla.—The C. H. Turner Company, Pensacola, Fla., has received a contract to construct a dock at Choctaw Point at the cost of $40,000 for the Texas Oil Company.

Dock, Old Point, Va.—The Boyle-Robertson Company has received a contract from Major Arthur H. Lloyd, construction quartermaster, Old Point Va., for the building of a dock upon the Government premises to cost about $111,000.

Dock, Wyandotte, Mich.—A. J. Dupuis & Company, 1022 Ford building, Detroit, Mich., has received a contract to build a dock at Wyandotte, Mich., to cost about $16,000.

Dredging, Mobile Bay, Ala.—The Atlantic Gulf & Pacific Company, Mobile, Ala., has received a contract to dredge 1,000,000 yards at Arlington Pier, Mobile Bay.

Earth Levee, Newport, Ark.—W. H. Dennison, Cushman, Newport, Ark., has received a contract to build a new earth levee at Newport, Ark., to cost about $165,000.

Dredging, Portland, Ore.—General Black, chief of the United States Engineer Corps, has recommended to the Secretary of War that the city of Portland be permitted to dredge the channel at the head of the Columbia slough. As the result of this action contracts will probably be signed with the Pacific Bridge Company for the carrying out of the work, which will cost about $309,450.

Jetty, Jacksonville, Fla.—Bids were closed on July 24, by the United States Engineer Office, Jacksonville, Fla., for the construction of a jetty at that place.

Lock and Abutment, Ohio River—The Dravo Contracting Company, Diamond Bank building, Pittsburgh, Pa., has been awarded the contract to build a lock and abutment at Dam 32 on the Ohio River.

Pier, Gulfport, Miss.—The city of Gulfport, Miss., began the construction of a pier about July 27. H. D. Shaw, city engineer, is in charge of the work.

Pier, Philadelphia, Pa.—Simpson & Brown, 90 West street, New York, has received a contract to build the Penn Treaty Recreation Pier, No. 57 North Delaware River, Philadelphia, Pa., at the cost of $75,156.

Pier, Toronto, Canada—The Department of Public Works, Ottawa, Canada, will soon let a contract for rebuilding a portion of superstructure of east pier at eastern entrance to Toronto harbor, 400 feet long, 30 feet wide. E. Lafleur, care of Department of Public Works, is the chief engineer.

Pier and Freight Shed, Astoria, Ore.—Bids were closed on July 1, by the Port of Astoria Commission, Astoria, Ore., for the construction of Pier 3 and freight shed No. 4, including all labor and materials except the electrical work, plumbing and sprinkler system and the hydraulic fill, which will be done by the Port of Astoria.

Pier and Fire Protection System, Bellevue, D. C.—The McHarg-Barton Company, 171 Madison avenue, New York City, has received a contract from the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a pier and installing a fire protection system at Bellevue, D. C., to cost $47,000.

Pier Sheds, Victoria, B. C.—Under the supervision of F. W. Cowie, harbor engineer, Montreal, Can., is constructing pier sheds on Number 17 and 18 Victoria pier. The work is being carried out by the Dominion Bridge Company.

Storage Tanks, Portland, Ore.—The Commission of Public Docks, Portland, Ore., closed bids on June 26 for the construction of six steel storage tanks to accommodate 16,000 barrels of vegetable oil at the St. John's import and export municipal terminal.

Terminal and Frame Freight House, Flushing, N. Y.—Bids were closed on July 15 by E. S. Walsh, Superintendent of Public Works, Albany, N. Y., for the construction of a barge canal terminal and frame freight house at Flushing, Borough of Queens, N. Y. Contract has been let to McHarg-Barton Company, New York City, for $151,340.

Warehouses—W. M. Sutherland Building & Contracting Company, Savanna, Ill., has received a contract to build forty warehouses to cost about $1,500,000.

Wharf, Berthier, Ont.—Bids were closed on July 24, by R. C. Desrochers, Department of Public Works. Ottawa, Ont., concerning a wharf which it is planned to build at Berthier, Ont.

Wharf, Comas, B. C.—The Department of Public Works, Ottawa, Ont., closed bids on July 15 for repairing a wharf at Comox, B. C., consisting of pipe and timber superstructure. 1,014 feet long, 20 feet 8 inches wide and 100 by 137 feet at the end, with about 300 piles. The estimated cost of the work is $20,000. E. Lafleur, chief engineer, Department of Public Works, is in charge of the work.

Wharf, Cornwall, Can.—Bids were closed on July 22, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Canada, for building wharf at Cornwall, Ontario.

Wharf, Magog, Quebec, Canada—T. P. Charleson, 149 Gilmour street. Ottawa, Ontario, Can., has received a contract from the Dominion Government, Ottawa, to build a wharf at Magog, Quebec, to cost about $14,924.

Wharf, Vercheres, Quebec—Contract has been let to L. & J. Trudel to rebuild a wharf at Vercheres, Quebec. The contracting company is located at St. Irenee.

Wharf, Williams Head Quarantine Station, B. C.—W. Greenlees, 47 Cordova street, Vancouver, B. C., has received a contract for repairing wharf 41 by 482 feet at Williams Head Quarantine Station, 9 miles southwest of Victoria, B. C., to cost about $19,415.

Wharf, Ste. Anne de Beaupre, Quebec, Canada—Bids were closed on July 23, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Ontario, Canada, for rebuilding and repairing wharf at Ste. Anne de Beaupre, Quebec, Canada.

Wharf, St. John, N. B.—The Engineers & Contractors, Ltd., 102 Prince William street, St. John, N. B., has been awarded the contract to construct a wharf at St. John, N. B., to cost about $28,500.

Wharf and Dredging, Powell River, B. C.—Bids were closed on July 31, by the Department of Public Works, Ottawa, Canada, for the building of an addition to wharf and dredging at Powell River, B. C., to cost about $165,000. E. Lafleur, Department of Public Works, is the engineer.

Hurley Resigns From Shipping Board

On July 10, formal announcement was made of the resignation of Edward N. Hurley as chairman of the United States Shipping Board, to take effect August 1. In view of Chairman Hurley's valuable assistance in carrying out the extensive shipbuilding programme, his resignation was accepted by President Wilson with reluctance.

Mr. Hurley intends to establish offices in the principal cities of the country where advice will be given to small manufacturers as to efficient means of carrying out the solution of particular business problems.

Although the statement is not official, it is supposed that John Barton Payne, of Chicago, will succeed Mr. Hurley as chairman of the Shipping Board.

Mark Hyman Appointed General Counsel of the Shipping Board

Mark Hyman, who as special assistant United States attorney general has prosecuted important cases in connection with Government anti-trust suits against the Eastman Kodak Company, and engaged in inquiries into the clay, fireproofing and conduit associations, the cement association, patent license restricting cases, and the recent Hog Island investigation, has been appointed counsel for the United States Shipping Board.

Charles R. Page, San Francisco, Cal., until recently a member of the United States Shipping Board, has been elected treasurer of the Atlantic, Gulf & West Indies Lines.

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Shipbuilding Changes at Greenock

Important changes in the control of several industrial establishments in Greenock and the surrounding district have either been made or are in process of being carried out. The engine works and foundry of Harland & Wolff (late Caird & Company) has been acquired by a Port Glasgow firm, whose name is not given out. Messrs. Harland & Wolff will, however, still be in the engineering business, and it is understood that the company will become identified with the firm of John G. Kincaid & Company, Greenock, which has large works in the east end of the town. The latter firm has no foundry. Within recent years this company has carried out very large extensions, and it is possible that further expansion will be undertaken in the near future.

Harland & Wolff contemplate an extension of their shipbuilding yard. If carried out this change will give employment to many more thousands of workers. It is also reported that two Port Glasgow Shipbuilding yards have changed hands. The business of W. Ferguson Bros. has been bought by Slater, London, who already controls the firm of Murdoch & Murray, Port Glasgow. The business will be carried on under the old name. Both of these Port Glasgow yards have reputations for turning out a splendid type of smaller craft. Ferguson Bros. have done much work for the Admiralty, for whom the company has built a large number of tugs.

The other firm reported to have changed hands is the Clyde Shipbuilding & Engineering Company. A London firm is said to be interested in the purchase. The Clyde business includes a fitting-out basin.

J. Samuel White & Company, Ltd., East Cowes, Isle of White, delivered the 1,000-ton displacement ocean-going torpedo-boat destroyer *Trusty* to the Admiralty rcently. The vessel was constructed, engined and fully equipped by the firm. It is the seventieth of the type produced by the company.

PERSONAL

E. O. Cutler, vice-president of the Groton Iron Works, Groton, Conn., and of the Virginia Shipbuilding Corporation, Alexandria, Va., following his resignation as manager of the former concern, which is now entirely controlled by the newly appointed receivers, is making his headquarters at the companies' New York office, 50 Broad street, in connection with the negotiation of new contracts to follow the completion of vessel contracts now under way with the Emergency Fleet Corporation. Both companies specialize in a standardized 9,400-ton steel steamer of the shelter-deck type. The combined yards have ten well-equipped ways for building steamers up to 15,000 tons deadweight.

John T. Cushing, assistant director of operations, has been stationed in Washington to act as director of operations during the absence of John H. Rosseter from the Capitol. He is assisted by W. F. Taylor.

F. C. Williams, formerly with the Division of Operations of the United States Shipping Board, has been appointed superintending engineer of the Cosmopolitan Shipping Company, 42 Broadway, New York city.

Rear Admiral David W. Taylor, U. S. N., chief of the Bureau of Construction and Repair, and Rear Admiral Robert S. Griffin, U. S. N., chief of the Bureau of Steam Engineering of the United States Navy, have been awarded the cross of the Commander of the Legion of Honor by the French Government.

Mrs. E. J. Schoonmaker has been appointed treasurer of the Bantam Ball Bearing Company, Bantam, Conn., upon the resignation of Miss Ruth Edwards.

At a meeting of the board of managers of the American Bureau of Shipping held on July 1, Commodore Ellsworth P. Bertholf, formerly commandant, and Captain Charles A. McAllister, Engineer-in-Chief of the United States Coast Guard, were duly elected members of the board of managers, and were also elected vice-presidents.

At a meeting of the Board of Directors of the Western Electric Company held on July 1, 1919, Charles G. Du Bois was elected president to succeed H. B. Thayer, who resigned after thirty-eight years of service to become president of the American Telephone and Telegraph Company. After graduating from Dartmouth in 1891, Mr. DuBois entered the accounting department of the Western Electric Company. In 1898 he was made secretary of the company, with offices at Chicago, having supervision over the branch houses. In 1917 he served as comptroller with the American Red Cross, rejoining the Western Electric Company as Vice-President in 1918.

Joseph J. Nelis, for the past year with the engineering section of the Emergency Fleet Corporation, Philadelphia, Pa., has accepted a position with the Power Specialty Company, 111 Broadway, New York, as marine representative for Foster boilers, superheaters and air heaters.

Admiral William B. Caperton, U. S. N., late commander in chief of the Pacific Fleet, was retired from active duty on June 30. Since his graduation from the United States Naval Academy in 1875, Admiral Caperton has served in all waters, including active duty in Cuba during the Spanish-American war, service in Latin-America during uprisings and revolutions, and from April 1917 to March 1919, as commander in chief patrolling the Pacific coast.

Announcement has been made of the appointment of William Baird as general agent, passenger department, of the Canadian Pacific Ocean Services, Limited, with office at the Pier Head, Liverpool, England.

Captain John W. Inglesby, for the past two years head of the sea service and sea training bureaus of the United States Shipping Board for the Hampton Roads district, resigned on July 1.

B. W. Morse has resigned as vice-president and general manager of the United States Steamship Company, New York, to re-enter the ship brokerage business, from which he had retired during the period of the war. Mr. Morse will continue on the board of directors of the United States Steamship Company and all subsidiary companies. He will be succeeded by his brother, E. A. Morse, who is also president of the Groton Iron Works, Groton, Conn., a subsidiary of the United States Steamship Company.

William R. Virtue, president of the Maritime Transportation Company, 11 Broadway, has resigned to become New York manager of Crowell and Thurlow, Boston, Mass., whose offices are located at 44 Whitehall street.

Robert W. Reford, president of the Robert Reford Company, Ltd., has been elected to the board of directors of the Cunard Steamship Company, Ltd., with which the former company is now affiliated.

OBITUARY

Oscar Otto, general superintendent of the South Philadelphia Machine Works, of the Westinghouse Electric and Manufacturing Company, died on June 30, as the result of fatal injuries received in an automobile accident four days previous. Mr. Otto was born in Manitowoc, Wis., where he finished his apprenticeship with the Central and North West Railway before serving with the Northern Pacific Railroad Company at Tacoma. Later he went with the Oregon Short Line, Salt Lake City, and in 1898 became superintendent of the Chicago shops of the Chicago and North Western Railway. In June, 1909, he became general superintendent of the Westinghouse Machine Works, East Pittsburgh, Pa., later supervising the installation of machinery at Essington, Pa., until he was transferred to the South Philadelphia plant.

William E. Simpson, formerly with J. F. Simpson & Company, New York and of late years in the service of the United States Government Assay Office, New York, died at his desk on July 11. Mr. Simpson, who was familiar with drydock construction, was the son of James E. Simpson who is said to have invented and built the first timber basin dry dock.

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